Engineering Library

"THE ENGINEER," SEPTEMBER 20, 1929

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

The Engineer.

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PUBLIC NOTICES

Board of Trade,

STANDARDS DEPARTMENT.

A VACANCY EXISTS for an ASSISTANT EXAMINER in the Standards Department of the Board of Trade, with establishment in H.M. Civil Service after two years' approved service. The duties are mainly in connection with the Control of Standards, and with the Examination of Weighing and Measuring Apparatus of novel types, with a view to their approval for use in trade.

Candidates, who must be British subjects by birth and the sons of fathers also British subjects by birth, should possess a University Degree (or its equivalent) in Science or Engineering, and should have had practical workshop experience. Preference will be given to ex-Service men.

The salary is £150, rising by annual increments of £15 to £300 per annum. To this scale of salary is added the usual Cost of Living Bonus, which at the present time varies from £82 18s. per annum on a salary of £150 to £123 5s. per annum on a salary of £300. Thus the total salary and bonus, calculated on the present basis for an Assistant Examiner at the minimum of the scale and at the maximum would be £232 18s. and £423 5s. per annum respectively.

The bonus is based on standard cost of living figures and is subject to periodical revision with the rise and fall in the figures, in accordance with the scheme of bonus applicable to Civil Servants generally.

Applications, with copies of testimonials, should be made in writing to the PRINCIPAL ESTABLISHMENT OFFICER, Board of Trade, Great George-street, Westminster, S.W. 1, not later than Wednesday, the 2nd October, 1929. 3218

Crown Agents for the COLONIES.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/1285.—ENGINEERING DRAUGHTSMAN REQUIRED by the GOVERNMENT of NIGERIA for service in the HARBOUR DEPARTMENT for two tours each of 12 to 18 months' service and possible extension. Salary £510, rising to £800 a year by annual increments. Free quarters and passages, and liberal leave on full salary. Candidates, age 25 to 35, must be experienced in the design of reinforced concrete wharves and other structures.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/1285. 3225

Armstrong College,

NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
2384 Newcastle-upon-Tyne.

Borough Polytechnic Institute,

BOROUGH-ROAD, LONDON, S.E. 1.

ENGINEERING DEPARTMENT.

COMPLETE COURSES extending over five years of evening work, leading to the Ordinary and Higher National Certificates.

Engineering Science.
Properties and Strength of Materials.
Heat Engines.
Theory of Machines and Machine Design.
Structural Engineering Drawing.
Structural Steel Work Design.
Reinforced Concrete Design.
Heating and Ventilation.
Refrigeration.
Motor Car Engineering and Design.
Engineers' Quantities and Estimates.
Engineering Economics.
Practical Mathematics.

Enrolment, 16th, 18th and 20th September, 7 to 9 p.m.

Prospectus will be forwarded on application.

J. W. BISPHAM,
3037 Principal.

Chelsea Polytechnic,

MANRESA-ROAD, CHELSEA, S.W. 3.

SPECIAL COURSES IN ENGINEERING METALLURGY.

In addition to the Courses in General Metallurgy, arrangements have been made for Special Courses of Lectures and Practical Work :—

(A) Engineering Metallurgy. Syllabus arranged to cover the syllabus of the Institution of Mechanical Engineers' Associateship Examination in Metallurgy.
(B) Heat Treatment of Metals.
(C) Testing and Mechanical Working of Metals.

The above classes are suitable for Engineers, Consultants, Engineering Students, Works Metallurgists.

COURSES BEGIN 23rd SEPTEMBER, 1929.

Full details on application.
Tel., Flaxman 0899. 3122

The Engineer

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SHIPPING, ENGINEERING & MACHINERY EXHIBITION, OLYMPIA, SEPTEMBER 12th-28th.
"THE ENGINEER'S" STAND will be No. 9, ROW D, at which all our friends will be Welcome.

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PUBLIC NOTICES

Heriot-Watt College,

EDINBURGH.

FULL TIME DAY DIPLOMA COURSES.

MECHANICAL ENGINEERING
ELECTRICAL ENGINEERING
MINING and OIL ENGINEERING
APPLIED CHEMISTRY and BREWING BUILDING.

AUTUMN TERM BEGINS OCTOBER 15th.

Full particulars from the College.
J. CAMERON SMAIL, O.B.E., Principal.
2609

City of Cardiff Education Committee.

THE TECHNICAL COLLEGE.

Principal - - CHARLES COLES, B.Sc. (Lond.).

The SERVICES will be REQUIRED in January next of a FULL-TIME ASSISTANT LECTURER in ENGINEERING, qualified to teach up to Honours B.Sc. standard. The main subjects required will be those of Mechanical Engineering and Civil Engineering, but a good knowledge of Electrical Engineering will be a recommendation.

Salary payable according to the Burnham Award.

Applications on foolscap paper, stating age, full qualifications, teaching and other experience, and giving copies of not more than three recent testimonials, should reach the Principal (from whom further particulars may be obtained) on or before Saturday, 5th October.

The successful candidate will be required to pass a medical examination by the Authority's Medical Examiner for Teachers at Cardiff before commencing duties, and to contribute under the Teachers (Superannuation) Act, 1925.

THOMAS McHOWAT,
Director of Education.
City Hall, Cardiff. 3219

PUBLIC NOTICES

Cape Technical College, Cape TOWN, SOUTH AFRICA.

LECTURER IN ENGINEERING.

APPLICATIONS are INVITED from persons who have had a sound technical training, supplemented by practical experience, for the vacant POST of GRADE I. LECTURER in the DEPARTMENT of ENGINEERING.

Salary according to scale £400 by £25 to £500 by £25 to £550.

The appointment will be subject to the conditions of service, which, together with College Calendar, may be obtained from the undersigned.

The successful applicant will be expected to assume duty by 1st February, 1930, and will receive travelling allowance to South Africa and also half pay for the voyage out.

Applications should be submitted IN DUPLICATE, to reach the undersigned by the 7th October, 1929, and should be accompanied by certified copies of testimonials.

Before appointment the production of birth certificate and a satisfactory medical certificate will be required.

This Department of the College undertakes the instruction of apprentices who are preparing for the Preliminary and National Technical Certificates of the Union Department of Education (see College Calendar), and applicants should, preferably, have had actual teaching experience of a similar nature.

CEALMERS & GUTHRIE (MERCHANTS), Limited,
3186 9, Idol-lane, London, E.C. 3.

Harris Institute, Preston.

The Council invite APPLICATIONS for the POST of FULL-TIME HEAD of the MECHANICAL and ELECTRICAL ENGINEERING DEPARTMENT.

Candidates should possess good academic qualifications and should have had workshop and teaching experience.

Commencing salary £500 to £600 per annum.

Further particulars and form of application may be obtained from the undersigned, to whom completed forms should be returned not later than Tuesday, October 1st, 1929.

E. C. MOYLE,
3200. Principal.

PUBLIC NOTICES

Imperial College of Science and TECHNOLOGY.

CITY AND GUILDS (ENGINEERING) COLLEGE.

DEPARTMENT OF ELECTRICAL ENGINEERING.

APPLICATIONS are INVITED for the APPOINTMENT of DEMONSTRATOR in ELECTRICAL ENGINEERING, City and Guilds (Engineering) College, commencing as soon as possible. Salary £300 per annum, with membership of Federated Superannuation System for Universities.

Candidates should have a degree or its equivalent and two or three years' practical experience in electrical engineering work, a part of which should have been spent in testing electrical machinery. Teaching experience is not essential.

Applications should be made by 1st October, 1929, to the SECRETARY TO THE DELEGACY, City and Guilds (Engineering) College, Exhibition-road, South Kensington, S.W. 7, from whom further particulars may be obtained. 3188

Administrative County of LONDON.

NORTHERN OUTFALL WORKS, BECKTON.

ADDITIONAL PURIFICATION PLANT.

CONTRACT "A."

The London County Council invites TENDERS for the CONSTRUCTION of AERATION CHANNELS, SLUDGE SETTLING TANKS, RE AERATION CHANNELS, and other WORKS for the Treatment of Sewage, entailing about 18,000 cubic yards of excavation, about 10,000 cubic yards of mass concrete, about 3500 cubic yards of reinforced concrete, and about 16,000 lineal feet of reinforced concrete piles and also drains, sludge pipes, foundations for pump house, &c. The new works will be situated at the Council's Northern Outfall Works, Beckton, on the north side of the river Thames, partly in the Metropolitan Borough of Woolwich, in the County of London, and partly in the Urban District of Barking Town, in the County of Essex.

The specification, bill of quantities, drawings and form of Tender may be obtained on application to the Chief Engineer, the Old County Hall, Spring-gardens, S.W. 1, upon payment of £10 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 3a, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 21st October, 1929, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
3237 Clerk of the London County Council.

Bethnal Green Board of GUARDIANS.

NEW WELL BORING.

The Guardians invite TENDERS for SINKING a BORE-HOLE at the Bethnal Green Hospital, Cambridge-road, London, E. 2. Contractors who have had experience in deep boring in the London area may inspect the specification for the work at the office of Mr. J. S. Alford, M. Inst. C.E., at 11, Victoria-street, Westminster, London, S.W. 1, and may obtain a copy of the specification and a form of Tender at the undermentioned address by payment of a deposit of £5, which will be returned to those firms who submit before the stipulated time a bona fide Tender and have returned all the documents entrusted to them.

Tenders must be received by the undersigned not later than One o'clock p.m. on Tuesday, the 22nd day of October, 1929. The Guardians will not necessarily accept the lowest or any Tender.

By Order,
C. FAULKNER JONES,
Clerk to the Guardians.
Guardians' Administrative Offices,
Bishop's-road, Bethnal Green, E. 2.
September, 1929. 3182

City of Plymouth.

SURPLUS PLANT.

TENDERS are INVITED for the PURCHASE and REMOVAL of the following SURPLUS PLANT :—

Five Babcock and Wilcox Land Type Boilers (fitted with Underfeed Stokers), with Economisers, Feed Pumps, &c.

Four Electric Generating Sets complete (in working order).

Negative Boosters, Centrifugal Pumps, &c. &c.

Conditions of sale, specification, and forms of Tender may be obtained on and as from 17th September from H. J. Hoare, City Treasurer, Plymouth; Tenders, sealed and endorsed "Surplus Plant," should be sent to the Chairman of the Stores Committee, Town Clerk's Office, Plymouth, by Noon on Wednesday, 2nd October, 1929.

R. J. FITTALL,
Town Clerk.
Plymouth, 13.9.29. 3198

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PUBLIC NOTICES

Holborn Union, London.

TO BUILDERS AND CONTRACTORS.

The Guardians of the Poor of the Holborn Union, in the County of London, invite TENDERS from persons willing to contract for the ERECTION of BALCONIES to the Wards of their Holborn and Finsbury Hospital, Archway-road, N. 19, in accordance with the drawings and specification prepared by their Architect.

The drawings, specification, and forms of Tender may be obtained from the undersigned at the Guardians' Offices, 53, Clerkenwell-road, E.C. 1, upon depositing £2, which will be returned upon receipt of a bona fide Tender.

Tenders must be signed, sealed and addressed to the Guardians and delivered to their offices not later than the 9th October, 1929, endorsed "Tender for Balconies, Holborn and Finsbury Hospital," and the same will be opened at a meeting of the Guardians on that day. Each person tendering must be prepared to give satisfactory references and sureties if required. The Guardians do not bind themselves to accept the lowest or any Tender.

No contract will be given to firms who do not ordinarily observe the recognised rates of wages and hours of labour.

CHAS. J. CROSS,
Clerk to the Guardians.

Administrative Offices,
53, Clerkenwell-road, E.C. 1,
18th September, 1929. 3243

Inverness and Moray County

COUNCILS.
NEW BRIDGE OVER THE RIVER SPEY.
CONTRACT FOR WORKS.

The County Councils of Inverness and Moray are prepared to receive TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE BRIDGE over the River Spey, near Grantown-on-Spey, and APPROACH ROADS thereto, as a whole or in two separate contracts.

The drawings, specifications, and schedules of quantities may be seen at the office of Messrs. Blyth and Blyth, Civil Engineers, 135 George-street, Edinburgh, and copies of the specification, schedule of quantities, and form of Tender obtained from them, on payment of a cheque for £5 5s., on and after Monday, 23rd inst.

An engineer will attend at the Palace Hotel, Grantown-on-Spey, on Wednesday, 2nd October, at 11 a.m., to exhibit the plans and point out the site of the works.

Sealed Tenders, marked on the outside "Tender for Spey Bridge and/or Approach Roads Contract," must be lodged with the undersigned not later than midday on Monday, 21st October.

The County Councils do not bind themselves to accept the lowest or any Tender.

E. D. JAMESON,
County Clerk of Moray.

County Clerk and Treasurer's Office, Elgin,
21st September, 1929. 3209

Port of London Authority.

The Port of London Authority are prepared to receive TENDERS for the EXECUTION for three years from the 1st April, 1930, of certain CONSTRUCTIONAL WORKS and REPAIRS to the BUILDINGS, RAILWAYS, ROADS and PREMISES (including River Banks, Towpaths and Shores) belonging to them or under their control.

The conditions of contract, specification, form of Tender and schedule of prices can be obtained on written application from the Engineer, Port of London Authority, London, E.C. 3, on making a deposit of £3 (cheques to be made payable to the Treasurer, Port of London Authority). The sum so paid will be refunded on receipt of a bona fide Tender and/or the return of the documents referred to.

Tenders, to be made out on the form provided, are to be returned on or before 10 a.m. on Thursday, 31st October, 1929.

The Port of London Authority do not bind themselves to accept the lowest or any Tender.

J. D. RITCHIE,
Secretary.

Port of London Authority,
London, E.C. 3,
20th September, 1929. 3184

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF CAST IRON WELL LININGS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of 100 SECTIONS of CAST IRON LININGS for WELL ADITS in accordance with specification and drawing No. 79 118/19, for delivery to their Deptford Pumping Station, Brookmill-road, Deptford, London, S.E. 8. The cast iron linings are 1ft. 8in. deep with six segments, each to form a ring 6ft. 2in. in diameter.

Tenders must be submitted on the official form, which may be obtained, together with copy of drawing, from the Chief Engineer by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelope, addressed to the Clerk of the Board and endorsed "Tender for Cast Iron Linings," must be delivered at the offices of the Board, Room 122, not later than 11 a.m. on Friday, the 11th October, 1929.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
17th September, 1929. 3210

Tyne Improvement Commission

EXTENSION OF QUAY AND TRANSIT SHED AT THE RIVERSIDE QUAY, ALBERT EDWARD DOCK.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the EXTENSION of their RIVERSIDE QUAY and TRANSIT SHED at Albert Edward Dock, North Shields.

Copies of the form of Tender, conditions of contract, specification and drawings may be obtained on and after the 25th September, 1929, on application to the undersigned on payment of a deposit of £3 3s., which sum will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes endorsed "Tender for Extension of Quay, &c.," and addressed to "The Chairman, Tyne Improvement Commission, Bewick-street, Newcastle-upon-Tyne," must be delivered at the undermentioned offices not later than Noon on Wednesday, the 16th October, 1929.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices,
Bewick street, Newcastle-upon-Tyne,
19th September, 1929. 3215

Egyptian Government.

APPOINTMENT OF TUNNEL DRIVING ENGINEER.

APPLICATIONS are INVITED for APPOINTMENT as RESIDENT ENGINEER for the Construction of a Canal Tunnel through rock near Naga Hamadi, in Upper Egypt.

Applicants must be of British nationality and possess the following qualifications :—

An Engineering Diploma.

Four years' experience with reputable firms, at least two of which must have been spent on actual practical tunnel work.

Salary £E800 per annum (£E equals £1 0s. 6d. approximately) free of Egyptian income tax.

The appointment is subject to medical examination.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt and also vice versa.

Initial period of contract 2½ years, commencing on the day of reporting for duty in Cairo.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application and specimen contract forms may be obtained from the

CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1,

to whom they should be returned with full particulars as to education, qualifications, previous experience, personal reference and copies of certificates or testimonials.

Envelopes to be endorsed "Tunnel Driving Engineer." 3176

PUBLIC NOTICES

Ashton-under-Lyne, Stalybridge and Dukinfield (District) Waterworks Joint Board.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT ENGINEER.

Candidates must be able to prepare plans, specifications and estimates for new work and also to supervise the construction of same. The duties will include the following :—The routine work of a Water Engineer's office supplying a population of 140,000 persons, the carrying out of repair work to the impounding reservoirs (7) and the gathering grounds (33,000 acres), the keeping of plans of all new mains within the area of supply up to date, the plotting on of new housing schemes, and the preparation of all drawings and other work necessary, also keeping in repair two mechanical filtration plants dealing with 5 million gallons per day.

The successful candidate must be capable of taking charge, when necessary, in the absence of the Engineer.

The appointment will be subject to one month's notice on either side, and to the provisions of the Local Government and Other Officers' Superannuation Act, 1922. The statutory contributions to the Fund under the Act being deducted from the salary.

Applications, stating age, salary required and full particulars as to qualifications and experience, accompanied by copies of three recent testimonials, must be delivered to the undersigned not later than 10 a.m. on Wednesday, the 2nd October, 1929, and endorsed "Assistant Engineer."

GEO. H. RADDIN, A.M. Inst. C.E.,
Water Engineer and Manager.

Town Hall Chambers,
Ashton-under-Lyne,
18th September, 1929. 3231

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

A QUALIFIED MECHANICAL and ELECTRICAL ENGINEER (24), 5 years' training with railway company, 2 years drawing-office and testing dept., followed by several months' commercial experience as representative, SEEKS SITUATION, either home or abroad.—Address, P6203, The Engineer Office. P6203 A

AGENTS for Leading Water Softener Makers REQUIRE a STEAM ENGINEER as SALESMAN for Yorkshire. Salary, expenses and commission paid.—Write, stating age, with full particulars, to Box 208, Sells, Fleet-street, E.C. 4. 3136 A

ASSISTANT WANTED for Works in West London district, to Supervise the Testing and Heat Treatment of Steel. State experience, education, and salary required.—Address, 3242, The Engineer Office. 3242 A

CONSTRUCTIONAL ENGINEERS in London REQUIRE SERVICES of STEELWORK DESIGNER with similar experience. Give full particulars, age, experience, &c. Permanency.—Address, 3223, The Engineer Office. 3223 A

INDIA.—REQUIRED for a Large Engineering Firm in India, DRAWING-OFFICE ASSISTANT for the Shipyard Department, with thorough experience of estimating and design of all types of Steam and Petrol-driven Launches and Vessels, mainly of the River Craft and Light Sea-going type. Applicants should also be able to interview clients, and conduct a certain amount of office correspondence. Copies of testimonials should accompany reply, and questions of salary and terms of appointment would be discussed at the interview in London.—Z. L. 181, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 3221 A

LEICESTER, DERBYS., AND NOTTS.—SALESMAN WANTED, to act as Sole Representative for a Firm of Heavy Weighing Machine Manufacturers. One already covering the ground with other lines and having a good connection amongst collieries, engineers, &c., preferred.—Address, 3192, The Engineer Office. 3192 A

LOCO. INSPECTORS REQD., S. America and Far East. At least 3 yrs. footplate exp. Age 27/35, single. £450/600 p.a.—Apply, LAURIE and CO., Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 3234 A

MESSRS. NEWTON, CHAMBERS and CO., Ltd., Thorncliffe, near Sheffield, REQUIRE an ASSISTANT MANAGER for their Ironworks Department. Applicants must be thoroughly well educated and with a minimum experience of five years in a responsible position in the works of a large constructional engineering and foundry firm. Age thirty to forty. Must possess initiative, determination, and tact.—Applications, stating salary required, should be addressed to the MANAGING DIRECTOR, and will be regarded as confidential. 3241 A

REQUIRED, First-class ASSISTANT for Large Structural and General Engineering Works in India. Applicants must have served full apprenticeship in engineering workshops, with subsequent technical training at Engineering College or University, and have obtained B.Sc. or B.E. degree. Good appearance and address essential. Public school man preferred. Single, age 25-28. Must be well up in structural work, able to estimate and check all calculations.—Write in first instance, to Box Z.B. 106, c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3, stating salary expected. 3152 A

REQUIRED for London Buildings, ONE or TWO ASSISTANTS, used to setting out Steel Work. Thoroughly accustomed to using instruments. State age, experience, and salary required.—Address, 3244, The Engineer Office. 3244 A

SUPERINTENDENT.—A Large FIRM in the Midlands REQUIRE the SERVICES of a capable MAN to Supervise the Design and Manufacture of Press Tools. Applicants must have had experience in similar work to motor car fenders and body panels, with up-to-date presses and marquette system.—Address, 3076, The Engineer Office. 3076 A

SUPERVISING ERECTOR REQUIRED by Leading London Constructional Engineers. Must be competent organiser.—Write in strict confidence, stating age, experience, and salary required, to Z.F. 154, c/o Deacon's, Fenchurch-avenue, E.C. 3. 3236 A

YOUNG MAN REQUIRED for Publicity Department of large Engineering Works. Good correspondent with experience in similar capacity essential. State full particulars, age and salary required.—Address, 3227, The Engineer Office. 3227 A

YOUNG ENGINEER REQUIRED as REPRESENTATIVE by Firm of Flour Mill Furnishers. State age, experience, and salary.—Address, P6194, The Engineer Office. P6194 A

WANTED, ASSISTANT MARINE ENGINEER-DRAUGHTSMAN, used to detail designing of Machinery for Tugs, Fishing Vessels, and small Coasters.—State age, experience, and salary expected, —CRABTREE and CO., Great Yarmouth. 3115 A

WANTED AT ONCE by Constructional Works on South Coast, TWO or THREE JUNIOR DRAUGHTSMEN, used to detailing Light Steel Structures.—Address, stating experience and salary required, P6192, The Engineer Office. P6192 A

WANTED, DRAUGHTSMAN for Manchester District with experience of Mechanical equipment of Electric Winders.—State particulars of age, experience, and salary, to 3214, The Engineer Office. 3214 A

WANTED for Cement Machinery Manufacturers, experienced MECHANICAL ENGINEERING DRAUGHTSMEN. Experience in Cement Machinery and Plant an advantage, but not essential.—Address, giving age, salary, and experience, 3204, The Engineer Office. 3204 A

SITUATIONS OPEN (continued)

WANTED for Temporary Employment in Railway Engineer's Office, Manchester, Steel Work, Permanent Way, Architectural and General DRAUGHTSMEN.—Address, giving age, qualifications, and salary required, 3205, The Engineer Office. 3205 A

WANTED IMMEDIATELY, Experienced DRAUGHTSMAN, with intimate knowledge of the Mechanical Handling of Cardboard and accustomed to Designing Machinery for the Production of Cardboard Boxes.—Address in strict confidence, stating experience and salary expected, 3043, The Engineer Office. 3043 A

WANTED, SENIOR DRAUGHTSMAN, with Machine Tool Experience, for Midlands. State full experience, age and salary required.—Address, 3174, The Engineer Office. 3174 A

BLAST-FURNACE DRAUGHTSMAN.—Large FIRM of Constructional Engineers REQUIRE the SERVICES of a SENIOR DRAUGHTSMAN with experience in Blast-furnace Plant, &c. Age, experience, and salary required.—Address, 3191, The Engineer Office. 3191 A

CHIEF DRAUGHTSMAN REQUIRED for Automobile Firm; must have first-class experience and be capable of producing results from the drawing-office quickly. Good opportunity for a pushful man.—Address, giving all particulars, P6195, The Engineer Office. P6195 A

DRAUGHTSMAN, GOOD SENIOR, With Experience of A.C. and D.C. Generators and Motors.—Address, stating age, qualifications, references, and salary required, to 3130, The Engineer Office. 3130 A

DRAUGHTSMAN REQUIRED, Experienced Only, modern Electric Crane design and details. State age, qualifications, salary, and when free.—STOTHERT and PITT, Ltd., Bath. 3228 A

DRAUGHTSMEN REQUIRED in the Newcastle-on-Tyne district, having sound working knowledge of Materials Handling Plant. Must have experience in detail and design of modern plant. State salary and give details of experience.—Address, 3202, The Engineer Office. 3202 A

DRAUGHTSMAN REQUIRED With Experience in the Design of Light Locomotives. State age, experience and salary required.—Address, 3230, The Engineer Office. 3230 A

DRAUGHTSMAN WANTED, Experienced in Railway Carriage and Wagon Work.—Apply, G. R. TURNER, Ltd., Langley Mill, stating experience and wages required. 3240 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

A New Air Speed Record.

ON Thursday of last week, September 12th, Squadron Leader Orlebar, flying the Supermarine Rolls-Royce "S 6" machine, which won the Schneider Trophy, succeeded in slightly surpassing the three-kilometre straight course speed record. From 355·8 miles an hour, he took the average speed for four consecutive laps of the course to 357·7 miles an hour. His successive lap speeds were 354·6, 358·7, 352·5 and 365·1 m.p.h. It is of interest to note that on the previous Tuesday, when the weather conditions were deemed to be partially unfavourable, his successive lap speeds were 368·8, 345·3, 365·5, and 343·7 m.p.h. It will therefore be seen that the highest speed on the Thursday was less than that achieved on two of the laps on the Tuesday. The figures provide a commentary on the effect of wind velocity on the speed of aircraft. They show, for example, that an aeroplane of given speed will perform a given journey, out and back, in the least time when there is no wind. It is a simple arithmetical fact and does not involve any aerodynamical considerations that the benefit of an assisting wind in one direction must always be more than lost by the hampering effect in the other direction. The fact that aircraft can now attain a speed equal to half the velocity of sound must have raised in the minds of many people questions as to whether, and, if so, how much, further progress in aircraft speed is possible. Monsieur Louis Blériot appears to have no doubt on the subject. He has expressed the belief that speeds as high as 750 miles an hour are attainable. It is, he argues, all a matter of landing speed. Seaplanes hold the air speed record at present, because it is easier for a high-speed machine to alight safely on water than on land. The floats of a seaplane are responsible for a very considerable drag and reduction of speed. Without them or with wheels such as are used on land machines the speeds already attained would undoubtedly be greatly exceeded. With improved means of alighting on land at high speeds, Monsieur Blériot is convinced that the velocity of flight will take another upward step. The maximum speed in flight twenty years ago was only one-tenth of what it is to-day. If, says Monsieur Blériot, it has been multiplied by ten in twenty years time it will certainly be multiplied by two in the next ten years. It is, perhaps, of interest to recall in this connection that when Monsieur Blériot flew the Channel twenty years ago his average speed was some forty-five miles per hour.

Shipyard Wages.

FOLLOWING a demand by the representatives of the trades unions connected with the shipbuilding industry for an all-round advance of five shillings a week in the wages paid to time workers, the Shipbuilding Employers' Federation made an offer to establish a uniform national time rate of £3 weekly for skilled plain time workers, and 41 shillings for unskilled workers. This offer would involve advances varying from 1s. to 5s. a week, and was accompanied by the assurance that men now in receipt of rates higher than the proposed uniform rate would not suffer a reduction in their pay. Last Friday, at a joint conference in London between representatives of the shipyard unions and the Employers' Federation, the trades union representatives expressed their approval of the principle of a national uniform rate but objected that the actual rates offered by the employers were inadequate in certain respects. They desire not only that the time rates should be increased, but that the principle of national uniformity should also be made to apply to pieceworkers and their assistants. The employers' representatives replied that the present position of the industry and its future prospects were such that they could not offer to increase the rates or extend the scope of their application. A general meeting of the executive bodies of the unions is to be held in London in the early part of October, and to it the employers' statement and explanation will be submitted for discussion.

Brookman's Park Wireless Transmitting Station.

ELSEWHERE in this issue we publish a description of the new regional transmitting station built by the British Broadcasting Corporation at Brookman's Park. It is primarily designed for the provision of an alternative programme service, and consists of two separate high-power transmitters. The alternative programme will not, however, be introduced until such time as listeners have become accustomed to receiving the single service programme from the new station. Test transmissions were begun at 12 p.m. last Monday, and are to be continued every night, with the exception of Sundays, until the end of the month. They are being made a few minutes after the close of the London programme, but on and after Monday, September 30th, the last section of the London programme will be transmitted from the new station every night with the exception of Sundays for two or three weeks. The date on which the Brookman's Park Station will take over the service entirely will be duly announced. Owners of valve sets living within 80 to 100 miles of Brookman's Park will eventually be provided with a service of alternative programmes, whilst it is expected that those possessing crystal sets who have a good outdoor aerial will be able to pick up the transmissions of the station at a distance of 50 miles. Listeners living within a radius of three to six miles of Marble Arch, who use crystal sets, will find the strength from the new station appreciably less than that to which they have been accustomed, and unless the components, including the aerial, are in sound condition, reception may be weak. The B.B.C. has prepared a pamphlet, entitled "Crystal Sets and the Brookman's Park Transmitter," which has been written with the object of assisting listeners who are likely to be affected by the change over.

Cement Works at Dover.

AMONG several schemes now being considered in connection with the development of the Tilmanstone Colliery in Kent is the establishment of a cement works at Dover. It is claimed that the raw materials for the production of cement—chalk, clay, and coal—are all found in the neighbourhood in ample quantity and of excellent quality. The colliery and the Dover Harbour Board have been in negotiation concerning a site for the erection of the works towards the east side of Dover Bay, close to the bunkers into which the coal from Tilmanstone is discharged by aerial ropeways. The negotiations have been prolonged, but it is suggested that they have now almost reached a conclusion, and that a beginning may shortly be made with the erection of the works. The new industry should do much to relieve the unemployment existing in the Dover area. At Tilmanstone the output is now about 7000 tons a week, and preparations are in hand for increasing it very considerably. The development work involved includes the deepening of two of the shafts.

Oil Fire.

THE Salt End Estate near Hull is the property of the North-Eastern Railway Company, which has developed it for the oil importing industry. Here there are numerous tanks for the storage of petroleum and other inflammable products; here also are special appliances to enable ships to charge or discharge their liquid cargoes at any states of the tide. For some reason, which has not yet been disclosed, one of these tanks, the property of the Anglo-American Oil Company, Ltd., containing, it is estimated, some half million gallons of paraffin "exploded" on Tuesday last "like a sudden crack of thunder, alarming the countryside and breaking the windows of all the adjacent buildings." The contents, of course, took fire, and the greatest fear was felt that many other tanks in the neighbourhood might become ignited. Close to the side of the blazing tank was another partly full of petrol. If it exploded there was every danger that the whole of Salt End would be involved. The fire brigades, therefore, devoted their principal attention to keeping this tank cool, as little or nothing could be done to reduce the fire in the paraffin tank. On the other side there was a tank of gas oil from which danger was also to be anticipated, and it also was cooled. Fortunately the wind was not blowing over the tanks, or a great disaster would have been inevitable. Great quantities of foamite were rushed to the spot. The latest reports indicate that the flames suddenly subsided, after burning for some twenty-six hours, before the contents of the tank had been completely consumed. It is suggested that the collapse of the roof and sides may have helped to smother the conflagration.

A Trade Union's Finances.

THE Council of the Boilermakers' Society has received as a result of a ballot vote authorisation to put into effect certain proposals designed to relieve the financial position in which the union finds itself. The immediate object of the proposals is to effect a balance between the union's income and expenditure, and to pay off a liability to the bank. A critical fact in the situation is that whereas in 1919 the membership of the union exceeded 100,000, it has now fallen to 66,000. To secure economy, the Council proposes to make a 15 per cent. reduction in the salaries of all full-time and part-time officials, and to reduce the salaries of members of the executive council from £6 to £5 2s. per week. The number of district delegates is to be reduced from twenty-one to fifteen, by dispensing with delegates from the Barrow, Clyde, East of Scotland, Tees and Hartlepool, Humber, and Midland districts. The salaries of the remaining delegates are to be reduced from £5 10s. to £5 per week. These economies in salaries will represent a saving of £1560 per year. In addition, twenty-six branches are to be closed, at a saving of £260 a year, and £400 is to be saved by holding less frequent meetings of the district committees. Adjustments on the expenditure side are to be made in the matter of superannuation allowances and sickness benefits. From 10s. a week for twenty-six weeks, the sickness benefit is to be reduced to 8s. 6d. for first-class members and 6s. 8d. for second-class members. The age for superannuation is to be raised from fifty-five to sixty years, and the membership qualification for this benefit is to be increased from thirty to forty years. The current income for superannuation purposes is stated to be £57,000 and the current expenditure £94,000. The amount paid per member last year on superannuation benefit was 28s. 6¾d., and on sickness benefit 11s. On dispute pay the expenditure was ¼d. per member.

Electricity in Northern Ireland.

THE development of the public supply of electricity throughout Northern Ireland is dealt with in a report covering the activities of the Ministry of Commerce and the Electricity Commissioners for Northern Ireland, under the Electricity Acts. It deals with applications for special orders, the establishment of new generating stations, extensions to existing stations, the construction of main transmission lines, and borrowing by local authorities for electricity purposes. Appendices to the report show the stage of development attained by undertakings giving public supplies of electricity under statutory powers, the capital expenditure and working costs of the various statutory undertakings, together with the fuel consumption, load factor, and sales of current under various headings. A notable feature in the record of the year's working is the increase in the electrical energy sold by the Belfast Corporation undertaking, but the consumption per head of population in Northern Ireland is still considerably below that in Great Britain. Reference is made to the powers granted by Parliament to the Antrim Electricity Supply Company for the generation of energy on the lower river Bann.

The British Airships.

ALTHOUGH the British airships "R100" and "R101" were at one time intended to be completed by the spring of 1928, they are in actual fact still not ready to take to the air for their first trial flight. The vessels are both of an experimental character, and numerous unforeseen difficulties have arisen to delay their construction. It is over a year ago since we saw the "R 101" in her shed at Cardington. She was at that date apparently being rapidly erected, but while we have had word since that she was being "gassed," it seems that even yet she is not ready for her test flights. This vessel, as our readers may recall, is to be driven by five heavy-oil engines. It is learned, however, that the power of these engines will be nearly 1000 H.P. less than what was originally intended, and that their weight and the weight of the cars in which they are housed will extend by about five tons, the amount originally estimated. In addition, one of the engines will be employed only for reverse driving. In view of these changes it is doubtful whether the speed of the vessel will reach the specified 70 miles an hour maximum or 63 miles an hour while cruising, and it seems fairly certain that on long voyages she will not be able to carry the hundred passengers for which accommodation has been provided. The causes for the delay in the completion of the airship Guarantee Company's vessel "R100" have not been revealed officially, but rumour suggests that they may have arisen from troubles of a metallurgical order.

New Power Stations.

WHILE a very fair number of new power stations has been put into operation during the past few years and important extensions have been made to many stations that have been in operation for a considerable time, up to the present the year 1929 has not been a particularly notable one from the point of view of power station development. Two important capital stations are, however, about to be put into service—the Hams Hall station, Birmingham, and the Portishead station on the Severn estuary, about 7 or 8 miles from the centre of Bristol. At the outset, the Hams Hall station will contain two 30,000 kilowatt generating sets, which will work at a periodicity of 25 cycles, but which have been designed so that it will be a fairly simple matter to convert them to 50-cycle units when the work of changing the periodicity in Birmingham has advanced sufficiently to demand a 50-cycle supply from this station. Five boilers, each having a normal capacity of 190,000 lb. per hour and a maximum capacity of 228,000 lb., are being installed, and they are all to be fired with pulverised fuel. The first section of the Portishead station is equipped with two 20,000-kilowatt, 50-cycle sets, but the ultimate capacity is to be 280,000 kilowatts. The second section of the station, which is now about to be put into operation, will contain a 50,000-kilowatt set, running at 1500 revolutions per minute, with the necessary boilers, mechanical stokers, condensing plant and switchgear. A 1560-kilowatt house service set has also been installed. The erection of the plant at both places has been fairly rapid.

Aluminium and Its Alloys.*

By Dr. A. G. C. GWYER, B.Sc.

(*Concluded from page* 283.)

Heat Treatment of Aluminium Alloys.

THIS constitutes one of the most important and far-reaching developments in the whole history of aluminium alloy metallurgy, so that I propose to devote a considerable proportion of this lecture to it.

From the historical standpoint, the first discovery of importance was made by Wilm approximately twenty years ago. He found that the alloy duralumin, now so widely known and used all over the world, after annealing at and quenching from a temperature of about 500 deg., did not acquire its maximum strength and hardness at once, but only after a lapse of several days, or, as we should say to-day, it exhibited the phenomenon known as "age hardening" at ordinary temperatures. When so treated, the tensile strength of duralumin increases from 35 to 45 kilos. per square millimetre, with no appreciable change in the elongation. Wilm himself was unable to offer any explanation for the changes produced by "ageing," nor was he able to correlate them with any obvious changes in the microstructure.

It was not until the year 1919 that the first theory of age-hardening was put forward. In that year, Merica and his colleagues at the American Bureau of Standards redetermined the solid solubility of $CuAl_2$ in aluminium at various temperatures and put forward the suggestion that the ageing of duralumin was due to the precipitation of ultra-microscopic particles of $CuAl_2$ from super-saturated solid solution in the aluminium. They considered that during the preliminary high temperature treatment at 500 deg. the copper was taken into solid solution, the amount so dissolved being dependent upon the time and temperature of annealing and being greater than that which can be maintained in equilibrium at room temperature. If now the alloy be allowed to cool very slowly, excess copper will be re-precipitated as $CuAl_2$, and no age-hardening will occur, the alloy being comparatively soft. If, on the other hand, the alloy be rapidly cooled, as by quenching, this re-precipitation will be wholly or partially suppressed, and the aluminium will remain in a state of super-saturation. According to this theory, metastable equilibrium can only be maintained by holding at extremely low temperatures. A certain amount of precipitation of $CuAl_2$ will occur spontaneously at room temperature, and more if the alloy be re-heated, the precipitation being followed by the coalescence of the $CuAl_2$ into larger particles. Merica suggested that the hardening was due to this process of precipitation and coalescence, and that the optimum properties obtainable by ageing were associated with a critical degree of dispersion.

Merica's theory that the "ageing" phenomenon was due to a finely dispersed precipitate aroused much interest and became widely accepted, but his statement that it was the $CuAl_2$ which was responsible was criticised. Hanson and Gayler, for example, found that the amount of hardening in the case of aluminium copper alloys was much less than in that of duralumin, and indeed was almost negligible at room temperature. They showed further that aluminium and the compound Mg_2Si form an eutectiferous pseudo-binary system, in which the solid solubility of Mg_2Si is considerably greater near the eutectic temperature than at room temperature. On quenching these alloys of aluminium and magnesium silicide from a temperature slightly below that of the eutectic freezing point, it was found that "ageing" took place at room temperature to a marked degree. Further investigation of certain quaternary alloys of aluminium with copper, magnesium and silicon not only yielded similar results, but also brought out that a further degree of age-hardening could be obtained by annealing the quenched alloys at approximately 150 deg. It would thus appear that "ageing" at room temperature is connected with the re-precipitation of Mg_2Si, whilst ageing at higher temperatures is connected with the separation of $CuAl_2$.

The problem cannot yet be regarded as finally settled, however, because in a recent paper by Archer, an account is given of duralumin prepared from very high purity and practically silicon-free aluminium, and it is shown that age-hardening still occurs and to as great an extent, as when the alloy is made up from ordinary aluminium containing appreciable silicon. Archer's opinion is that the presence of magnesium lowers the temperature of deposition of the $CuAl_2$, thus confirming Merica's contention that $CuAl_2$ was the hardening constituent.

Aluminium silicon alloys age-harden only slightly, but they are of theoretical interest, because by means of chemical analysis it is possible to trace the course of re-precipitation in them, when the dispersion of the silicon is so great that microscopic examination is unavailing. Thus, when these alloys are attacked by a mixture of sulphuric, nitric and hydrochloric acids, the free silicon present is unattacked and appears in the residue as such. The silicon, which is present in the dissolved state, that is, in solid solution, is oxidised by the mixed acids and appears in the residue as silica, SiO_2. The colour of the residue furnishes a valuable clue to the amount of free silicon. For example, on annealing an alloy with 1 per cent. silicon for a prolonged period at 570 deg. and quenching, the residue obtained by chemical analysis was pure white and consisted wholly of SiO_2, indicating that the whole of the silicon had been present in the aluminium either in solid solution or in combination. After re-annealing at a comparatively low temperature, the same alloy gave a coloured residue, the intensity of the colour affording evidence of the amount of the silicon re-precipitation. Re-annealing at 300 deg. for varying times yielded residues of varying tints, the colours ranging from pale brown to black. Black residues were obtained after a twenty-four hours' anneal, but it needed a week's anneal before the silicon particles became of such a size as to be microscopically resolvable.

The precipitation theory of age-hardening has not met with universal acceptance, most of the objections being based upon the view that in its simplest form it does not satisfactorily explain the changes in the electrical conductivity which occur during the ageing of duralumin. It was demonstrated by Fraenkel and Seng, and also independently by Konno, that when duralumin is tempered, the electrical resistance decreases, as indeed one would expect, if tempering be due to the rejection of Mg_2Si, or $CuAl_2$, from solid solution. On the other hand, when the alloy is aged at room temperature, the electrical resistance continuously increases, and the two German workers were able to show that the rate of increase with time is similar to that of a monomolecular reaction. Fraenkel, Seng and Scheuer, therefore, put forward the theory that immediately after quenching, the alloy consisted of an unstable solid solution in which, during ageing at room temperature, a chemical reaction took place, the product being retained in solid solution. This is the stable condition at room temperature, but at higher temperatures, the compound is unstable, and the alloy reverts to the heterogeneous state. Our President, Dr. Rosenhain, has suggested that the high electrical resistance of a solid solution is due to the distortion of the lattice brought about by stranger atoms, and inferred on theoretical grounds that the rejection of these atoms and their subsequent coagulation into crystallites would further increase the distortion, and so long as the disturbance in the lattice structure increased with further deposition, so long would the electrical resistance increase also. These views have recently received striking confirmation from the work of Gayler and Preston, who carried out a series of determinations of the changes in density, hardness, electrical resistance, and lattice parameter occurring during the ageing of certain alloys. They were able to show that the changes in density and in lattice parameter were quite consistent with precipitation taking place, and the X-ray analyses also indicated that the crystals themselves were in a condition of severe internal strain, which was gradually relieved by further ageing at high temperatures. The electrical resistance rose to a maximum and afterwards fell, corresponding changes being observed in the hardness. The process of ageing would appear to consist of two overlapping stages—first, the rejection of the stranger atoms, magnesium silicon and copper from the lattice, accompanied by increasing lattice distortion, increasing hardness and increasing resistivity; secondly, the combination of the rejected atoms into molecules of $CuAl_2$ and Mg_2Si, and their coagulation into crystallites. The second stage is accompanied initially by a further increase in the lattice distortion, hardness and resistivity, but subsequently when coagulation has become appreciable, the resistance begins to fall, the hardness diminishes, and the lattice distortion is relieved.

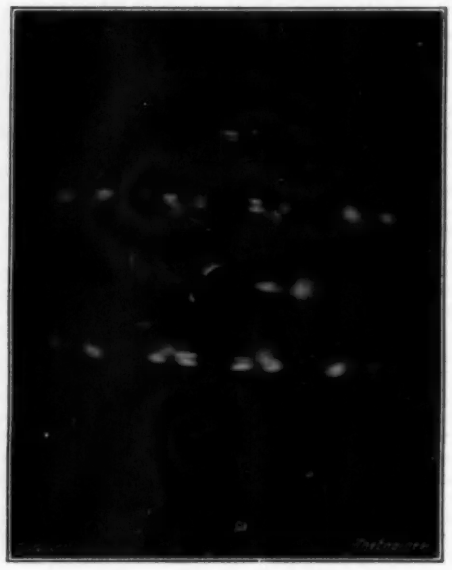


FIG. 9

Spectrograph of Hard-drawn Aluminium Wire.

Age hardening has now been shown to be of very general occurrence, and to be capable of wide application commercially. Among the wrought alloys, duralumin takes the first place, and its heat treatment consists in heating to 480 deg. ± 10 deg., and immediately quenching in water, the final properties being reached after allowing the metal to age for at least four days at room temperature.

Another important alloy is that known as "Y." It was developed by the National Physical Laboratory, and is used in both the cast and wrought states. Its composition should approximate to—

	Per cent.
Cu	4
Ni..	2
Mg	1½

The heat treatment consists in annealing for three-quarters of an hour at 510–520 deg., quenching in boiling water, and ageing for at least five days at room temperature. Bingham has shown that the magnesium in the "Y" alloy is present chiefly as Mg_2Si, and any excess is dissolved in the aluminium-rich solid solution. Nothing is known as to the constitution of the iron constituent.

In Germany, especially since 1924, considerable attention has been given to the alloys of aluminium with copper and silicon, and one, in particular, has been developed by the Vereinigte Aluminium-Werk under the title "Lautal." According to Fuss and Bohner, the heat treatment consists in annealing at 480–500 deg. and quenching, but as the alloy does not age spontaneously at ordinary temperatures, it is given a prolonged low-temperature anneal at 120 deg. after the quenching. The properties of "Lautal" are very similar to those of duralumin.

Very few of the alloys which are heat treated contain zinc, and therefore the introduction of the alloy known as "Constructal 8" is of interest, as it is an aluminium alloy with magnesium and zinc, which owes its age-hardening properties to the compound $MgZn_2$.

One of the most important developments in the application of precipitation heat treatment is that which is typified by the alloys "Aldrey" and "Almelec," which are coming into use for electric transmission work. Zeerleder and Bosshard have published a very full account of the alloy "Aldrey," which contains approximately ·4 per cent. magnesium, ·5–·6 per cent. silicon, and ·3 per cent. iron. Wires, for example, are heat treated during the drawing process by annealing at 570 deg., quenching, and ageing between 140–180 deg. for a prolonged period. As compared with pure aluminium, these alloys have over 80 per cent. of its electrical conductivity and approximately twice its tensile strength.

X-Ray Spectrography.

The application of the methods of X-ray spectrography to aluminium, although dating only from 1917 when Hull showed that the metal possessed the face-centred type of cubic lattice—parameter 4·05 A.U.—has been of very great value practically as well as theoretically, and much more is to be expected from it in the future.

As regards the pure metal, recent investigations have been concerned with the mechanism of deformation and with the development of preferred orientation by the cast, worked, and annealed crystals. In the case of aluminium alloys, attention has been directed to the change of lattice parameter in the solid solubility ranges and to the crystal structure of the intermediate constituents.

The orientation of the crystals in cast aluminium has been studied by Czochralski and Schmid, who were able to show that the columnar crystals growing inwards from the exterior of the ingot were so oriented that in general the edge of the elementary cube was parallel to the direction of growth.

A large number of investigations have been carried out in order to ascertain the structure of worked aluminium. Although the mechanism of deformation of a multi-crystalline metal has not as yet been completely elucidated, it has been established that permanent deformation entails a rotation of the crystal axes so that one of the more important crystallographic directions tends to become parallel to the direction of applied stress, and this is accompanied by a fragmentation of the original crystals and by some buckling or bending of the lattice. Fig. 9 shows the diffraction spectrum given by a typical sample of hard-drawn aluminium wire, irradiated by a beam of X-rays from a molybdenum anticathode and containing two prominent wave lengths K_α and K_β of 0·706 and 0·633 A.U. respectively, the beam of X-rays being normal to the wire axis. Had the orientation of the crystals been entirely at random, the spectrograph would have consisted of a series of concentric circles, the so-called Debye-Scherrer rings, the two innermost being produced by the diffraction of the K_α and K_β waves by the atoms in the octahedral planes of the aluminium lattice, the next two by diffraction at the cube planes, and so on. In the wire, however, since the crystals are not oriented at random, but possess a considerable degree of alignment, the various diffracted beams are concentrated in certain directions in space and the diffraction images limited to certain well-defined intensity maxima. In order to produce a diffraction spectrum such as this, the majority of the crystals must, as was shown by Ettisch, Polanyi, and Weissenberg, be aligned in

* The Institute of Metals, Eighth Annual Autumn Lecture, Düsseldorf, September 10th, 1929.

the manner shown diagrammatically in Fig. 10. The cube diagonals of the lattices lie parallel to the axis of the wire, but, as indicated by the arrow, in the transverse plane the orientation is entirely random. Such a structure is termed fibring, and in the present instance the axis of fibring, the cube diagonal—or to use the general crystallographic notation the (111) direction—lies parallel to the wire axis. Exact analysis by Schmid and Wassermann has shown that the fibre axis is only exactly parallel to the wire axis in the centre of the wire. Towards the outer portions the fibre axis is slightly inclined, the angle of inclination reaching its highest value a little below the surface.

As far as I am aware, no investigations dealing with hot-rolled sheet have as yet been published, but from work carried out in my laboratory it would appear

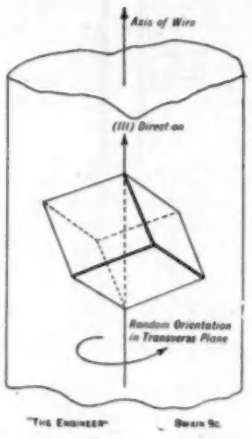


FIG. 10

Orientation of Elementary Cube in Hard-drawn Aluminium Wire.

that the crystals tend to take up a position with the face diagonal of the elementary cube parallel to the direction of rolling and a cube face parallel to the rolled surface.

The orientation produced by hot rolling does not appear to be an equilibrium one, and the first effect of cold rolling is to produce a somewhat random structure and ultimately another type of preferred orientation is developed.

Fig. 11 shows the spectrograph obtained from severely cold-rolled aluminium sheet. The orientation is largely preferred, and the crystals are so fine that individual reflections cannot be distinguished. Analysis shows that a (112) direction is parallel to the direction of rolling, and a dodecahedral face is parallel to the rolled surface. This is in agreement with the work of Mark and Weissenberg, and with

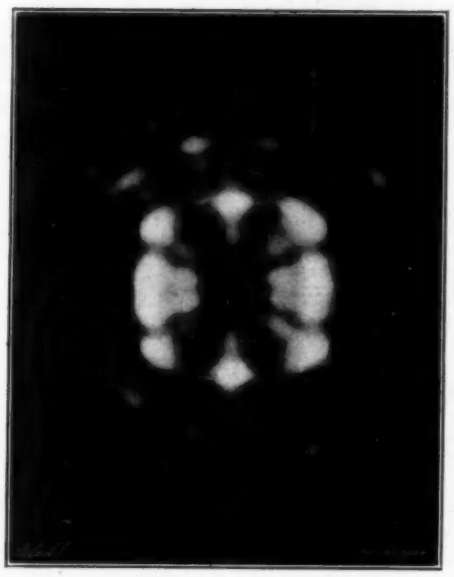


FIG. 11

Spectrograph of Cold-rolled ·0485" Aluminium Sheet.

that of Norton and Warren. Wever has shown that there is a second possible type of preferred orientation in aluminium sheet, in which the cube diagonal—(111) direction—is parallel to the direction of rolling, and a dodecahedral face lies in the rolled surface, and his work has been confirmed by Owen and Preston. As far as I am aware, no one has yet explained the reasons for these different types of structure.

Proceeding now to aluminium alloys, those with copper have been the subject of several investigations. The compound $CuAl_2$ has a tetragonal lattice, but a difference of opinion still persists with regard to the arrangement of the atoms within the unit cell. Gayler and Preston have shown that the solid solution, saturated with respect to copper at 500 deg., has a lattice parameter of 4·031 A.U., as against 4·041 A.U. for pure aluminium. The intermediate phase δ, stable at room temperature, was found by Westgren to have a cubic lattice, with from 49 to 52 atoms in the elementary cube, according to the composition.

The aluminium-silicon alloys are eutectiferous, the spectrographs showing the lines of both elements, silicon having the diamond type of cubic lattice. As far as I am aware, the change in lattice parameter brought about by the addition of silicon has not been determined. The "normal" and "modified" types of silicon alloy give identical spectrographs.

I have endeavoured in this brief summary to give you some idea of what X-ray spectrography has already done for aluminium metallurgy, even although its application may still be considered only just beginning. It is hardly necessary to point out that the mechanical and physical properties of any metal must be influenced by the arrangement of the crystals, and that the conditions of the lattice itself, as regards freedom from distortion, cannot be without effect, not only on the immediate properties, but also upon the ultimate durability of the material.

The Brookman's Park Wireless Broadcasting Station.

THE new London regional transmitting station at Brookman's Park built by the British Broadcasting Corporation, began test transmissions for the public at midnight, Monday, September 16th, on a wave length of 356·3 m., or 842 kilocycles. The station stands in a 34-acre field, which is exceptionally flat, and is about 400ft. above sea level. The building itself occupies about three quarters of an acre. Besides the actual transmitting station, there is a power station containing four 300 horse-power six-cylinder oil engines running at a speed of 300 revolutions per minute, and in order that use may be made of a buffer battery, the engines are coupled to 220-volt direct-current generators, as shown in Fig. 1 on page 304. At the back of the main building there are two large oil tanks, each holding 75 tons of oil, for running the engines. Alongside these tanks is a cooling tower for cooling the circulating water of the engines. There is also a building containing a boiler for heating the building by means of radiators, and as the heat is derived from the exhaust gases of the engines, the heating is carried out on the most economical lines possible. When the engines are not running, however, an oil-fired boiler is put into service.

The storage battery, which has a capacity of 2000 ampère-hours, is capable of taking over the load of one of the engines temporarily, in the event of failure. Its primary object, however, is to provide the station with current when the transmitters are not at work, and when the load is therefore very light. Adjoining the battery room is a space for storing various spare parts, and a workshop for carrying out repairs. Beyond this there is the main motor generator room, shown in Fig. 2 on page 304, containing six large motor generators and a number of small machines. In the centre of the room there are three 160-kilowatt machines, each capable of giving this output at any direct-current voltage between 7000 and 12,000. These sets provide the supply for the anodes of the main transmitting valves. Each of these motor generator sets consists of three machines on a single bed-plate. The driving motor is coupled to two generators, each having two 3000-volt commutators, so that the two double commutator machines in series can give 12,000 volts.

The station is capable of transmitting two programmes at the same time on two wave lengths, and when the station is working at full load two motor generators will be in use. One will supply each transmitter, whilst the third will serve as a spare for either transmitter. The three other large machines have been installed for the purpose of heating the filaments of the transmitting valves, and each is capable of giving 1300 ampères at any pressure between 15 and 30 volts. There is one machine for each transmitter, and one acts as a spare for either transmitter, the arrangement, therefore, being the same as that of the high-tension machines. The small motor generator sets, to be seen in Fig. 4 on page 304, supply the negative grid voltages and provide the separate anode supplies for the drive and modulated amplifier stages of the transmitters. As in the case of the larger machines, all these small machines consist of three units.

The next and largest room is the transmitter hall, which contains the two transmitters. These stand along each of the side walls, and face each other, whilst at right angles to the two transmitters is the main switchboard which controls the output from the machines just described. In the middle of the room there are two control tables for the transmitters. Directly beneath the transmitters and switchboard is a vault, 7ft. deep, which contains all the wiring between the switchboard and transmitter, and the various accessories, such as the pumps for the circulating water for the transmitting valves. There are also two small storage batteries for heating the filaments of the drive valves, which demand a steady voltage in order to prevent slight changes of frequency. Normally, each transmitter delivers 30 kilowatts to each aerial, and employs modulation at low power. Briefly, the arrangement is as follows:—First of all there is the drive stage with special arrangements to keep the frequency constant to within about 200 cycles. The output from the drive valve is applied to the separator stage, which is followed by the modulator amplifier, which is the stage in which modulation takes place, and where the power level is approximately ¼ kilowatt. The output from the modulated amplifier operates the first power stage, which consists of two water-cooled valves and the output of this stage operates the final stage, which consists of a maximum of eight valves on each side of a neutrodyned push-pull system. One of the transmitters and part of the main switchboard is shown in Fig. 3 on page 304. The output circuit is coupled to a feeder system carried overhead on steel standards, which runs to small buildings immediately below the down lead of each aerial. These buildings contain the aerial transformer apparatus, which, of course, includes the aerial timing circuit.

The water circulating system for the water-cooled valves in the transmitters works on the closed system. Water stored in two large closed tanks on the roof of the building circulates through the valve jackets and passes into two larger tanks in the vault. It is then pumped through a radiator, over which ordinary mains' water is sprayed, and having passed through the radiator it is pumped back to the overhead tanks. By adopting this closed system, it has been possible to use distilled water instead of hard water, which causes scale to form on the anodes of the valves. The radiator system, which is outside the building, consists of banks of pipes standing over a cooling pond. All the pumps, &c., for this system are in the vault immediately below the transmitters, so that wastage of water by evaporation is reduced to a minimum.

All the units of each transmitter are entirely enclosed and screened from each other. Glass panels with gauze behind them are provided to enable the transmitters to be viewed whilst they are at work. Safety devices make it impossible for operators to open the doors of any of the units without first of all cutting off the current. Apart from these precautions, however, the station has not been designed on so-called "fool-proof" principles, as it was considered preferable to employ engineers who are sufficiently well trained to do without elaborate safety schemes.

Leading out of the main transmitter hall are two control rooms in which the programme is received from the telephone lines running to Savoy Hill, which are laid underground in order to secure reliable operation. These two rooms, one for each transmitter, contain all the necessary amplifiers, controlling and, monitoring gear. The front part of the main building is occupied by offices, mess rooms, kitchen, &c., and two sound-proof listening rooms for checking quality by means of loud speakers. There is also a test room for taking precise measurements of the performance of either transmitter and a small studio for local speech or music tests.

Four 200ft. masts, of the self-supporting type, insulated from earth at the base, serve for supporting the aerials, two of the masts serving for one aerial, and the remaining two for the other. The span between the masts is 600ft., whilst the distance between the centre lines of the aerials is 900ft. The height of the aerials is very much less than is desirable from an engineering point of view, but unfortunately there are Government restrictions governing the height of masts in the district, and a height of 200ft. was the maximum that could be adopted. At the top of each mast there is a red electric lantern for the purpose of warning aeroplane pilots not to attempt to land in the neighbourhood of the station. The earth system radiates from the aerial transformer houses and consists of a number of wires buried 1ft. below the surface of the ground, the ends of the wires forming an oval extending about 200ft. on each side of the aerial and 150ft. beyond each mast.

UNDOUBTEDLY, says the Guaranty Survey, published by the Guaranty Trust Company, of New York, one of the most important developments in the rubber industry in the last few years is the discovery of processes whereby reclaimed rubber is restored to industrial usefulness. The low price of crude rubber from 1920 to 1922 minimised the importance of reclaimed rubber, but during the subsequent period of high-priced crude rubber American scientists made extensive research into reclamation processes—in fact, the Stevenson Act owes its failure not a little to the extensive use of reclaimed rubber in the United States. At first the utilisation of reclaimed rubber was looked on with doubt in several foreign countries, but by 1926 it had been demonstrated that reclaimed rubber when treated by processes that have been perfected by the intensive research of American chemists, could be mixed with crude rubber without impairing the quality of the product, and it has even been shown that the addition of a certain amount of reclaimed rubber actually improves some products. The fact that several large consumers of rubber in the United States have erected plants for the treatment of reclaimed rubber for their own use suggests that the reclamation of rubber is far from a temporary expedient. At present levels of about 20 cents a pound, it is still profitable to use the reclaimed product.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. II.*

HUNT AND MITTON, LTD.

AMONG the great variety of valves and fittings shown on the stand of Hunt and Mitton, Oozells-street North, Birmingham, some of the most noteworthy are the forged steel valves, shown in Figs. 21, 22 and 23. They are, of course, designed for

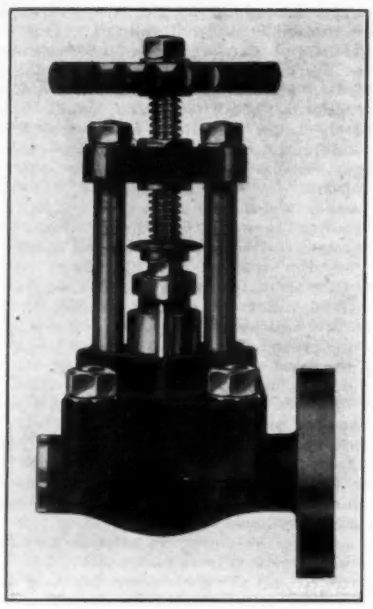


FIG. 21—AIR RELEASE VALVE—HUNT AND MITTON

services with high-pressure superheated steam where, otherwise, cast steel bodies would be necessary to carry the increased stresses, and to prevent the "growth" which is characteristic of cast iron when exposed for long periods to high temperatures. It is noteworthy that these valves, although their manufacture involves some heavy machining operations, can be supplied at prices competitive with those having cast bodies. This is accounted for, of course, by the facts that the rejection of waste castings is eliminated, and that the drop-forged blank lends itself

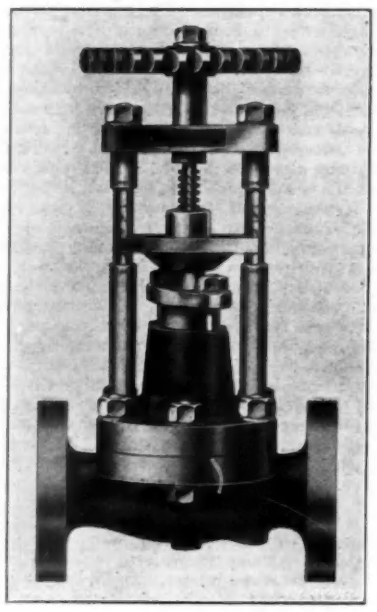


FIG. 22—FORGED STEEL VALVE—HUNT AND MITTON

more readily to fixture in a jig, so that the most intensive methods of machining can be adopted.

As will be seen from the drawing, these valves are of the straight through type. They are made in sizes from 1¼in. upwards. The hand wheel does not rise with the opening of the valve shown in Fig. 22 as it is used to operate a bronze nut, into which the stainless steel spindle screws. The stuffing-box is exceptionally deep, and is provided with a reversed seating—see Fig. 23—against which a collar on the spindle abuts when the valve is fully opened. In this way steam can be cut off from the stuffing-box, so that the packing can be renewed with the valve under steam. The air release valve—shown in Fig. 21—is of the parallel slide type, and is generally fitted with a plain nozzle, but may be arranged for union connections if required. An incidental merit in the use of these valves is that, being machined throughout the bore, they offer a minimum resistance to the passage of steam.

Another exhibit on this stand is the mechanical lubricator—illustrated in Fig. 24. It is intended for giving a positive drop by drop feed of oil to any number of branches against, if necessary, a pressure

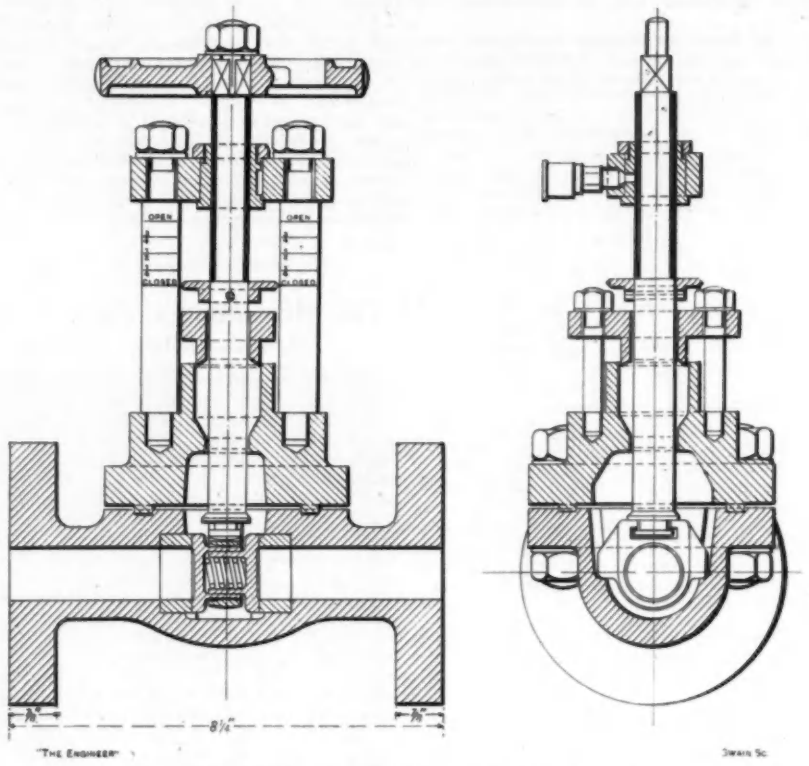


FIG. 23—FORGED STEEL VALVE—HUNT AND MITTON

of 3000 lb. per square inch. The lubricator is built up by fixing together a number of circular cast iron sections, one for each feed branch, each of which contains a pump and its driving mechanism, &c. These sections are 100 mm. in outside diameter by 20 mm. wide. The moving parts are held and guided by a rectangular machined sleeve supported by three arms cast on the inner periphery of the section. Up and down this sleeve, guided by two grooves machined in its walls, move two crossheads, one operating the suction valve, the other the pump piston, the former

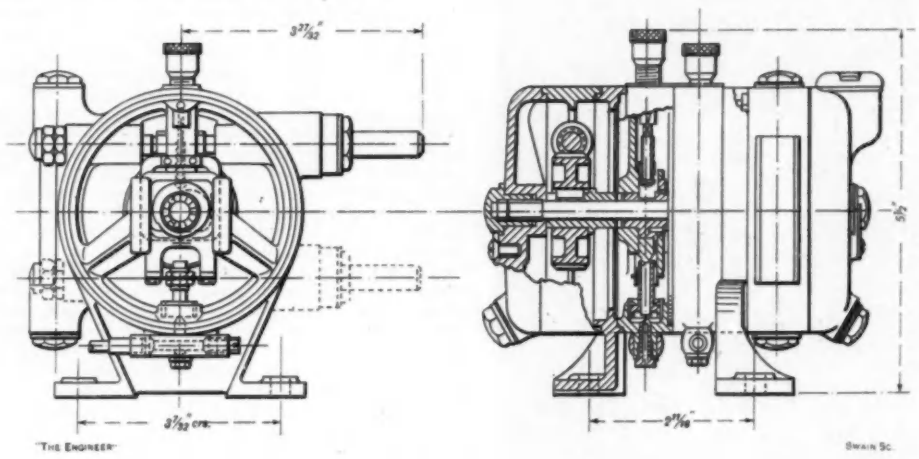


FIG. 24—MECHANICAL LUBRICATOR—HUNT AND MITTON

having a comparatively short lift (2 mm.) and being greater in diameter than the piston. Its centre forms the walls of the chamber through which the piston moves. Passing through the crosshead there is a hollow cam shaft, hollow to allow the passage of the central spindle that holds the sections together. This cam shaft is toothed at both ends to permit of its engaging with the similar shaft of neighbouring feeds, so that when a series of pump units is assembled these cams are as one shaft and can be rotated all together by a common driving gear unit situated at either end of the lubricator or in the centre, as may be preferred. Only one cam is machined solid with the shaft, and this moves the crosshead operating the pump piston, but fitted on the shaft immediately adjoining this cam is an excentric operating the suction valve crosshead. The cam and excentric are so shaped and arranged that the action of the suction valve and piston are perfectly synchronised, irrespective of the direction in which the lubricator is rotating.

When the piston is at the bottom of its stroke, the suction valve is mechanically opened, the piston commences to rise and oil is admitted into the oil delivery chamber partly by the action of gravity and partly being drawn thereinto by the suction of the retreating piston. When the piston is at the top of its stroke the suction valve is closed again mechanically, and held closed whilst the piston descends on its delivery stroke, forcing the oil in the delivery chamber out through a small spring operated valve into the feed pipe and so in time to its destination.

It is claimed by the makers that this valve gear cannot fail through being gummed up on a cold morning with thick oil or because some grit has settled on the valve seating. The powerful positive closing of the cam operated valve will break through any such obstacle and so one of the chief causes of failure in some mechanical lubricators is entirely removed.

An adjustment for the length of stroke of the pump is provided in each section, and allows the rate of feed to be varied from nothing up to eighty drops per minute. It is recommended that the number of piston strokes per minute should not exceed twenty-five, and should not be less than five.

MONEL-WEIR, LTD.

The extensive display of machinery, ships' fittings, and industrial and domestic articles made of "Monel" metal, which is to be seen on the stand of Monel-Weir, Ltd., is an indication of the extended uses to which this natural alloy of high nickel content can be put. An interesting exhibit is a small marine condenser, in which two nests of "Monel" metal tubes are arranged in such a way that both the interior and the exterior of the tubes can be examined. Each of the tubes has a length of 11ft. 6in., and is ⅝in. external diameter, with a thickness of 20 S.W.G. The tubes are illuminated by means of electric lamps placed in

* No. I. appeared Sept. 13th.

one of the water heads, and the highly polished internal surface can be noted. A series of ± two-thousandths limit gauges is available in order to test the bore and diameter of the tubes, and their concentricity, which are shown to be within these very fine limits. Such tubes are being employed in an increasing degree in mercantile and naval ships, and the demand for them has been so marked that the firm has recently opened the new Zenith tube works at Thornliebank, Glasgow, in which the materials are handled under ideal conditions, assuring great purity of metal and cleanliness in the manufacturing process. We understand that tubes with a length of 16ft. and in diameter up to 4in., which latter tubes are specially required for industrial and chemical processes, are now available in "Monel" metal.

Other examples of machinery in which the same alloy is employed for valves, valve seats, and spindles, include a Weir turbo-feed pump, with a designed output of 7000 gallons per minute, which only weighs a little over 10 cwt. The "Monel" metal nozzle plates and turbine wheels for this unit are also displayed. The direct-acting feed pumps include two models, one with an output of 405 gallons per minute, and a pump bore of 3in., a steam cylinder bore of 4½in., and a stroke of 6in., running at a speed of 25 double strokes per minute. Perhaps the smallest and lightest feed pump in the Exhibition is the Weir "Junior" feed pump, which has a designed output of from 50 to 150 gallons per minute, with a pump bore of 1¾in., a steam cylinder bore of 2½in., and a stroke of 3in. We were interested to learn that the price of this pump, which can be lifted in one hand, is about 6s. per lb. weight. Part of the display is devoted to turbine blading, which is now manufactured by Monel-Weir, Ltd., in all kinds of materials. Blading of "Monel" metal has been employed in the high-pressure stages of the main propelling and auxiliary turbines of practically all recently completed high-pressure turbine-propelled ships, and for the low-pressure stages the firm is now making blading in nickel-chromium-iron. Packing pieces of "Armco" iron are also on view. Other uses of the "Monel" alloy are illustrated by an extensive series of ships' fittings for deck, cabin and galley service, while numerous examples of chemical and industrial process plant are shown on the stand.

Super-Centrifugal Engineers, Ltd.

It might be said, in brief, that the aim of the designer of the machines shown on the stand of Super-Centrifugal Engineers, Ltd., whose address is 101, Grosvenor-road, London, S.W. 1, has been to develop a centrifuge for separating liquids of different densities that is characterised by the fact that its axial length is great in comparison with its diameter. We illustrate in Figs. 25-28 two of these machines, which are shown in operation, together with a general cross section through the essential parts and a drawing of the suspension of the bowl.

In support of the policy of adopting a small-diameter bowl, running at a high speed, the makers put forward the following theory :—

For a given peripheral speed the centrifugal force increases as the diameter decreases, because decrease in diameter means a greater change of direction in a given time—*i.e.*, a sharper corner to turn. On the other hand, the tensile stress on the structural material of the cylinder is in direct relation to the peripheral speed, not the revolutions per minute.

This will be evident from the formula for centrifugal force—

$$\text{C.F.} = \frac{\text{W}\,v^2}{g\,\text{R}}$$

where W = weight, lb.; v = velocity, feet per second; g = gravity; R = radius in feet.

It follows that for centrifugal bowls of given peripheral speed, the tensile stress is the same, even though one, through the use of a small diameter, may generate many times the centrifugal force of the other.

Conversely, with a given centrifugal force, tensile stress increases as the diameter of the bowl increases. It follows that as the requirement for centrifugal force increases, the diameter of the bowl must decrease.

The machine itself, as will be seen from Fig. 26, consists essentially of a long hollow cylinder or bowl, which is revolved at a speed of 15,000 to 17,000 r.p.m. As the drawings show, the bowl—which has a length of approximately 30in. and a diameter of 4½in.—is suspended by means of a flexible steel spindle from a simple ball bearing. A boss which extends downward from the bottom of the bowl enters a guide bushing, flexibly held in position by a spring. With such a mounting the rotating bowl can, obviously, take up its own position, and no appreciable stress is imparted to the housings. It is driven by a 2½ B.H.P. motor, which runs at a speed of 3500 r.p.m. In the type of machine exhibited the driving belt is of woven cotton and the desired degree of tightness is maintained by a weighted jockey pulley. A light hand brake is fitted near the bottom of the bowl casing for stopping the machine at the end of a run.

The oil enters the bowl through a passage in the bottom which coincides with the aperture of the feed tube. A three-vaned wing piece is fixed within the bowl, so that the liquid to be treated is always maintained at the same speed as the rotating shell. The oil passes up the walls of the bowl with a smooth streamline flow until the discharge orifices in the top covers are reached. Separate outlets are arranged for oil and water, which lead to the discharge pipes. In the design of the machine illustrated in Fig. 28, the whole of the top part of the purifier is enclosed by a large D-shaped door, which gives easy access to the covers and the bowl, and is stated entirely to do away with oil fumes. Any solid matter which may be separated out from the oil remains in the bowl, and as this component consists only of three simple parts, while it does not weigh more than 37 lb., it can be quickly lifted out and cleaned. The whole operation of shutting down the centrifuge, taking out the bowl, cleaning and replacing it, and again bringing the machine up to speed, does not take, we are informed, more than 10 minutes.

An important advantage of the Sharples oil purifier is the very small gyroscopic force which is set up by the narrow and lengthy bowl employed. The absence of large gyroscopic forces enables the machine to work smoothly and continuously, we understand, in any part of a ship, even in a heavy seaway.

The Universal System of Machine Moulding and Machinery Company, Ltd.

As is indicated by the name of this firm, whose offices are at 13, Wilson-street, London, E.C. 2, it is largely interested in the manufacture of foundry equipment, but on this occasion it is confining itself to a display of pulley block lifting gear—an example of which is illustrated in Fig. 29.

The outstanding feature of these blocks is that they are made of wrought steel throughout. As a consequence they are light for their capacity, and

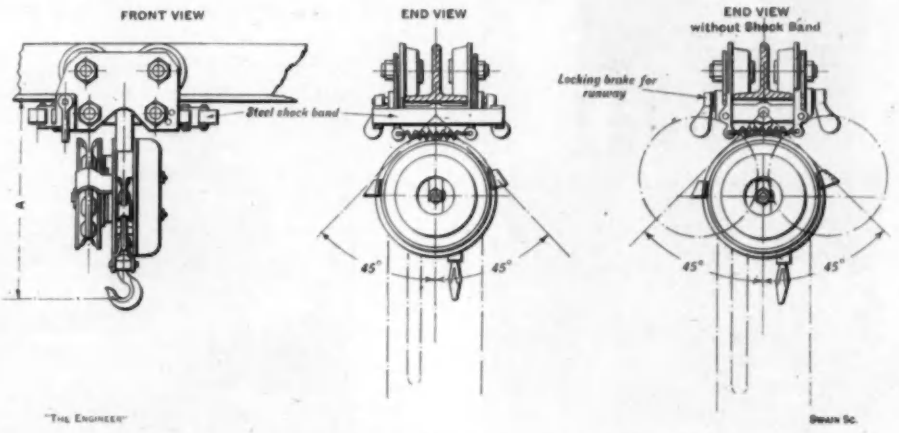
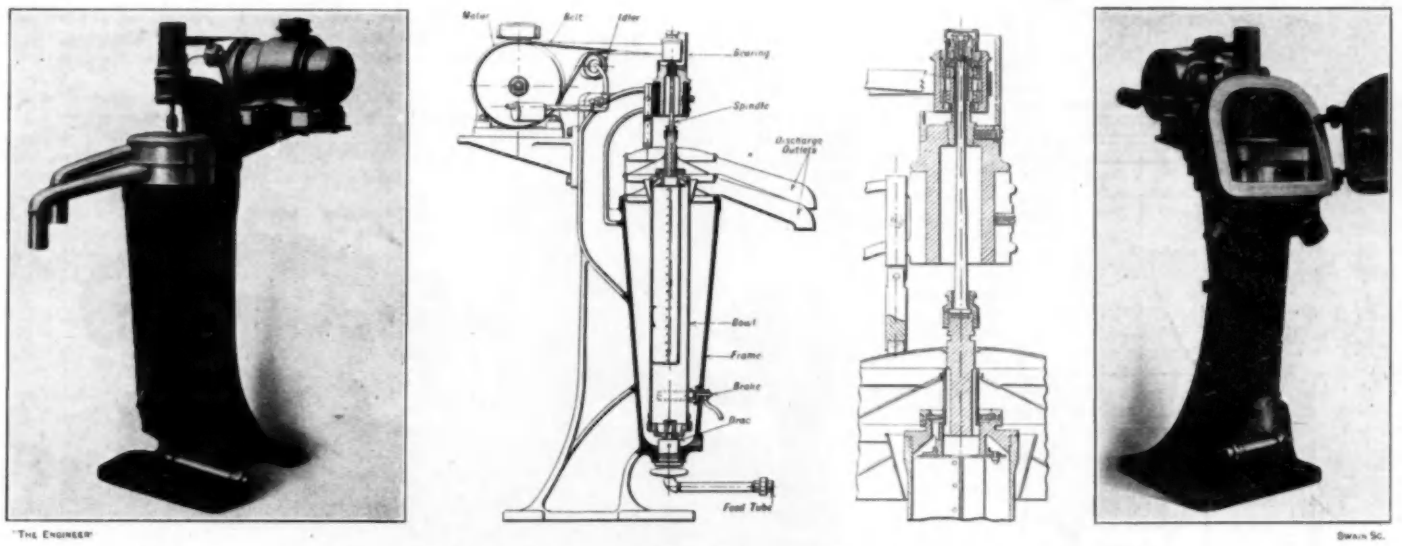


FIG. 29—WROUGHT STEEL PULLEY BLOCK—UNIVERSAL MACHINE MOULDING

are correspondingly small in overall dimensions. Thus in the ½-ton size only 10½in. headroom is required above the hook in its highest position, and 20½in. is enough for the 2-ton size. The gear wheels, which are totally enclosed, and are machine cut, give a triple reduction in speed. The ratchet for sustaining the load is also machined from the solid and is case-hardened, while there is a direct brake for lowering purposes. As shown in Fig. 29 the pulley block is intended for use on shipboard, where its small headroom is a great advantage. It is mounted on a small runway trolley, which is provided with two spring brakes, so that in any position on the girder the block is free to swing, transversely through an angle of 45 deg. on either side of the vertical. Springs are provided to prevent shocks as it swings, if the ship should be in a seaway. Incidentally the block will quite conveniently pick up a full load when swung out to the greatest extent.



FIGS. 25 TO 28—CENTRIFUGES FOR SEPARATING LIQUIDS—SUPER-CENTRIFUGAL ENGINEERS

A. G. Mumford, Ltd.

The exhibits on the stand of A. G. Mumford, Ltd., of Colchester, are devoted to the various types of pumping machinery manufactured by the firm. One of the principal exhibits is a newly designed electrically driven "Vertex" pump, reference to which has already been made in our issue of August 9th. The unit on view at Olympia is, as Fig. 30 indicates, a duplex pump with a centrally placed worm drive. Each barrel has a bore of 3in. with a stroke of 3in. and the designed speed is 90 to 100 r.p.m. All the bearings are of the ball or roller type, which ensures silent running and a high mechanical efficiency. It may be noted that the reciprocating parts of the pump are enclosed in oil-tight casings, which, however, are readily detachable and allow good access to the pump rods and glands.

G

The drawing shown in Fig. 31 is a vertical section through one cylinder of the "Vertex" pump showing the valves and motor drive. From the lower part of the drawing it will be seen that the valves are of robust construction. The pump bodies may, we are

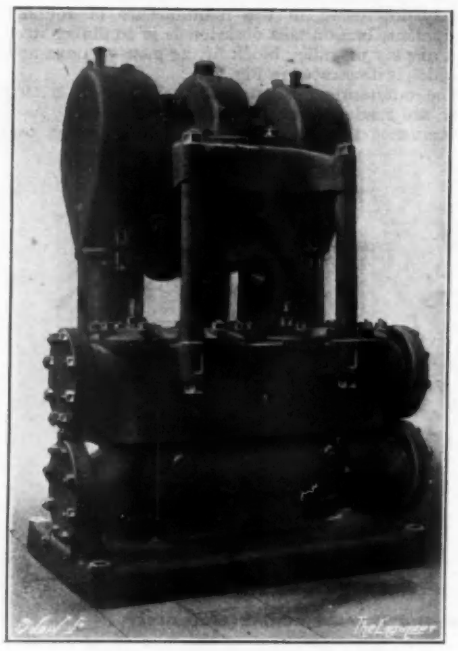


FIG. 30—"VERTEX" PUMP—MUMFORD

informed, be made either in cast iron or gun-metal with or without liners, and with different valves to suit the varied duties for which the pump may be used. On the low-pressure side these duties include general service, bilge, ballast, and fresh water pumping, oil

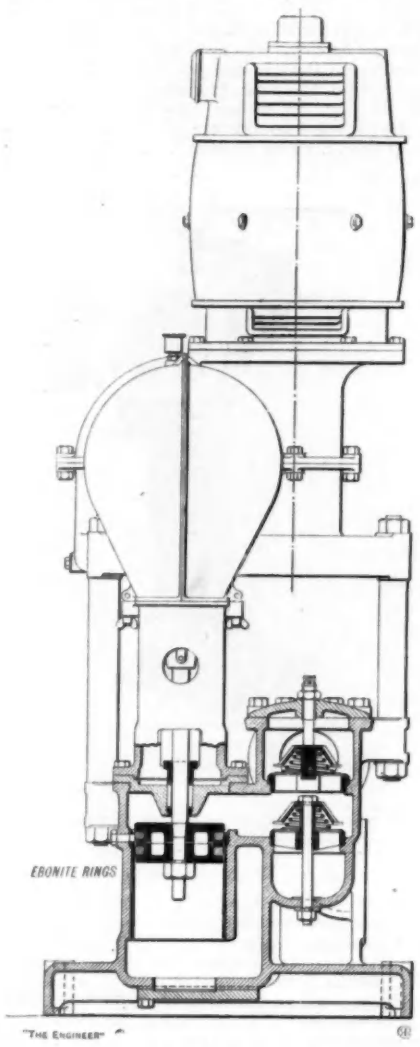


FIG. 31—SECTION OF "VERTEX" PUMP—MUMFORD

fuel transfer and lubricating oil services, while on the high-pressure side pumps for oil fuel burning equipment may be designed to deal with pressures up to 150 lb. per square inch. The principal features of the "Vertex" pump may be said to be its silent running, the small space occupied, and a saving in weight of 25 to 30 per cent. as compared with an ordinary spur gear driven pump. Fig. 30 shows a "Vertex" pump with a horizontal motor drive.

A noteworthy exhibit is the 2000 r.p.m. 1in. bore "Centricone" pump, which was described in our Supplement issue of September 9th, 1927—see Fig. 33. This pump has no wearing parts except the bearings and impeller. The impeller, as the name implies, is cone-shaped, and is furnished with threads on its outer periphery. The impeller spindle carries an adjustable bearing which enables the impeller clearance to be altered as required. It can be supplied either as a horizontal or vertical spindle pump and is self-starting after it has been primed. With a constant-speed motor the pressure can be increased to three times the normal working pressure, which enables the pump, when utilised for brine circulation, to deal effectively with a block in the brine system. Both the pumps above referred to are shown in operation so that visitors can judge for themselves the silence of running and the steady pumping of these units.

We show in Fig. 32 a horizontal oil fuel pressure pump of the "Simplex" type with patented positive-action valve gear arranged on the end of the cylinder. The steam cylinder has a bore of 4½in. with a stroke of 6in., and the pump bore is 3in. The pump has been specially designed for oil fuel and is fitted with an adjustable spring-loaded by-pass on the delivery valve with a return lead to the suction, which enables the discharge pressure to be varied as may be required. Another small pump shown is a hand-operated oil

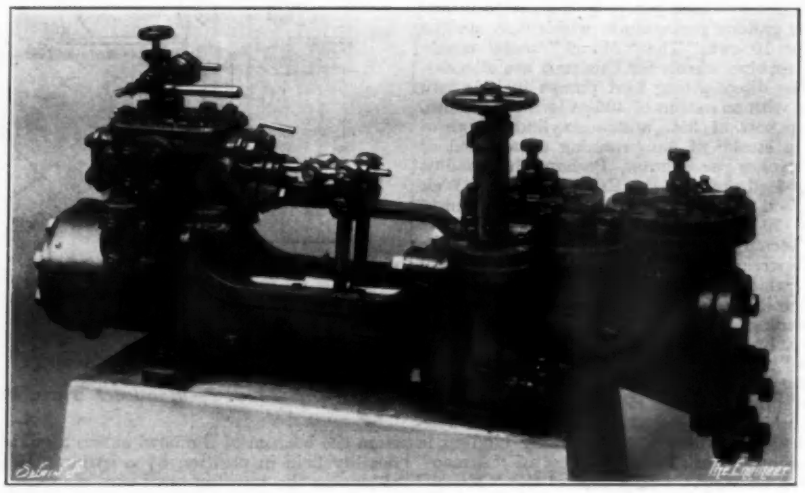


FIG. 32—HORIZONTAL OIL FUEL PRESSURE PUMP—MUMFORD

fuel pump with 1½in. diameter rams and a stroke of 3in. The pump is of the double-ram type and is specially designed for lighting up services. It can readily be attached to a bulkhead and is intended to draw fuel from the double-bottom tanks and deliver it to the burners. Its small size enables it to be placed in convenient positions in the ship.

The firm is also exhibiting sectioned models of the Mumford patented feed water regulator and check valve, which apparatus has been fitted to practically all the large high-pressure turbine-driven liners recently constructed either at home or abroad.

A.C. WELDING COMPANY.

Visitors to the Exhibition who are interested in A.C. welding and cutting processes should not fail to inspect the exhibits on the stand of the A.C. Welding Company, of City Mills, High-street, Stratford. The "Alternarc" multi-characteristic plant, shown in Fig. 34, consists of a transformer unit mounted within an oak case, provided with sedan handles. The transformer is air-blast cooled, an electric fan, fitted with ball bearings and connected to tappings on the primary winding, being mounted in the rear of the machine case to provide ventilation, as shown in Fig. 35. The case is made weatherproof, and can be used outdoors as well as indoors. Removable louvres are provided at the forward and rear ends of the case to give free passage to the air current set up by the fan. The transformer consists of a core, carrying on the upper leg the primary and main secondary windings, and on the lower leg an auxiliary winding, while between two extensions of the core, a movable flux diverter is provided. Tappings from both the main and auxiliary secondary windings are brought out to plug-in sockets on the front of the machine case, the left-hand set of sockets being coupled to the main secondary and the right-hand set to the auxiliary secondary. A plug is provided in connection with each set of sockets, movement of the left-hand plug providing adjustment of the voltage and characteristic curve of the plant to suit the type of wire to be used, while the right-hand plug affords rough adjustment of the current according to the size of electrode and nature of the work. Fine adjustment of the current and arc length is obtained by adjustment of the movable flux diverter by means of a brass handle protruding through the top of the machine case. The primary winding leads are brought out for

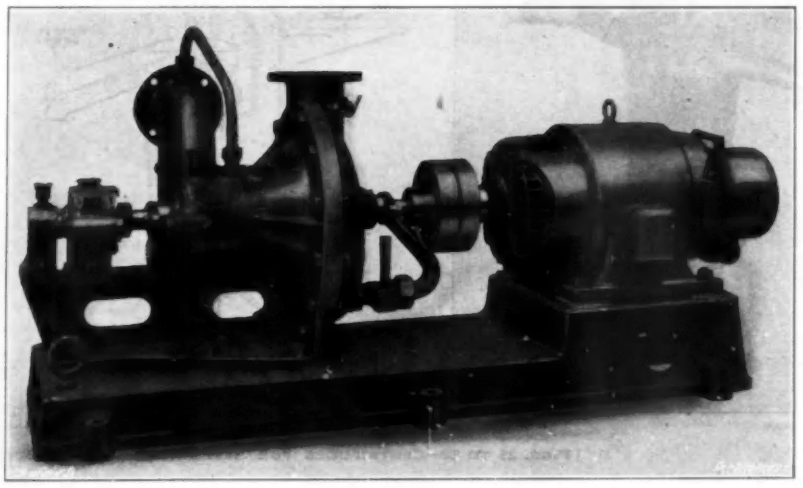


FIG. 33—HIGH-SPEED "CENTRICONE" PUMP—MUMFORD

connection to a terminal box at the rear of the machine, and 5 per cent. and 10 per cent. low-voltage taps are provided for adjustment, should the line voltage be low. As a dissipating resistance for high voltage surges a lamp is fitted, and this also serves to indicate that the plant is ready for use. The "Alternarc" multi-characteristic type machine is said to conform to the most exacting requirements from the standpoints of welding efficiency, electrical efficiency, and safety, whilst its reliability, portability, low first cost, and low cost of installation render it suitable for use in shipyards, steel works, &c. The machines are made in four sizes for welding and cutting, the capacity ranging from 125 to 350 ampères. In another type of machine the diverter is absent, fine adjustment of the current being obtained by means of a plug in conjunction with a second series of sockets connected to the auxiliary winding. These

machines are cheaper than the multi-characteristic type. The firm's "Light Welder"—125 ampères—and "Standard Welder"—175 ampères—are designed for sixteen-step current adjustment, while the "Heavy Welder"—225 ampères—and "Cutter and Welder"—360 ampères—have a current adjustment in twenty-five steps. Large machines for heavy welding and cutting at 600 ampères and for extra heavy cutting at 1200 ampères are made. Two other machines are worthy of note. The first is known as the "Alternarc Commercial," while the other is called the "Garage Special." These

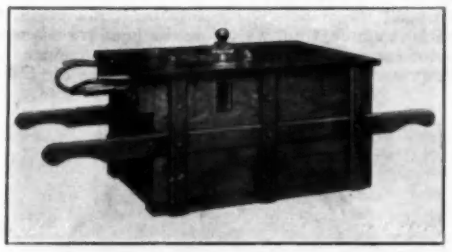


FIG. 34—A.C. WELDING EQUIPMENT—A.C. WELDING

models are intended for intermittent duty and for the use of general engineers and in garages where occasional repair work is undertaken. The transformer in each case is naturally cooled, and is arranged vertically in a rigidly built case. The range of adjustment of these machines is wide in relation to their continuously rated capacity and they are therefore only suitable for continuous welding duty on the lower current steps. The "Alternarc Commercial" machine has a continuously rated capacity of 125 ampères, and a range up to 175 ampères, whereas the "Garage Special" is rated continuously at 75 ampères

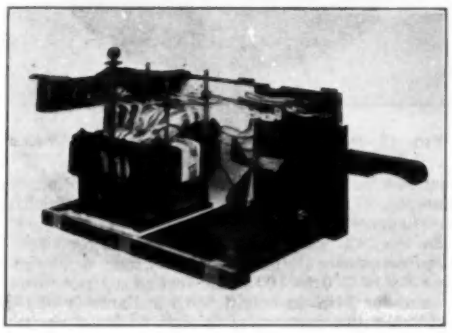


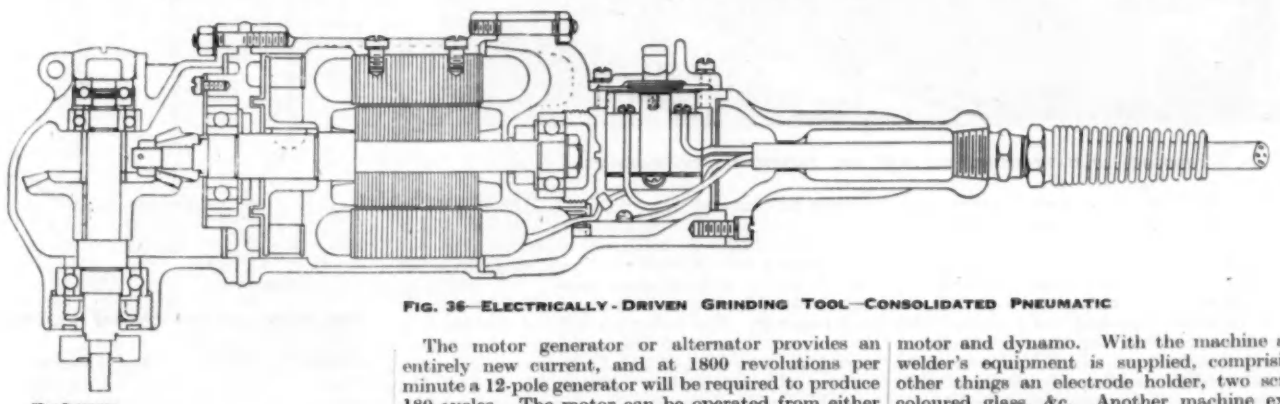
FIG. 35—INTERIOR OF A.C. WELDING EQUIPMENT—A.C. WELDING

and has a range up to 125 ampères. The firm's "Alternarc" equipment and "Newarc" electrodes are also exhibited.

The operator's helmet and hand shield supplied are strong and light, while the welding and cutting handles are said to stand up well under heavy duty. The A.C. Welding Company claims to be the pioneer in this country of the lightly coated types of flux-coated electrodes. Since the first introduction into this country of these wires, steady improvement has been made in the flux and wire, and a comprehensive range of various types and grades is now on the market.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, LTD.

The chief attraction on the stand of the Consolidated Pneumatic Tool Company, Ltd., of 170, Piccadilly, London, W. 1, is a selection of electrically-



"THE ENGINEER"

FIG. 36—ELECTRICALLY-DRIVEN GRINDING TOOL—CONSOLIDATED PNEUMATIC

operated tools of the new Hicycle type. They include drills, grinders, screw drivers, sanders, &c.; in fact, all kinds of small tools which require a rotary drive. We give a cross-section through one of the grinding tools, in Fig. 36, as being typical of their general arrangement.

The peculiarity of these tools is that they are comparatively small and light for the service which they will render. This result is attained by using a high-frequency alternating current in the motor, so that it can be run at a high speed and develop a proportionately large power for its size.

The general idea of these tools is based on American practice, and, as a consequence, their design assumes an electric supply with a frequency of 60 cycles. The synchronous speed of a two-pole 60-cycle motor is 3600 revolutions per minute, and therefore it is at a disadvantage, when compared with a direct-current motor, as regards weight, as the latter can be easily made to run at a speed of 16,000 revolutions per minute, or even more. The speed of the direct-current motor certainly does fall off under load, but even then it is greater than that of the 60-cycle motor. The only way of increasing the speed of the alternating-current motor is by increasing the frequency of the supply, and a frequency of 180 cycles per second was adopted for the high-frequency portable tools, which gives a synchronous speed of 10,800 revolutions per minute in the two-pole motor used. This is considerably less than the average free speed of the direct-current or universal tool, which is very high. The bearings, which are generally of the ball type have therefore a longer life. The slip under normal full load is 8 per cent. to 10 per cent., giving an average loaded speed of about 9800 revolutions per minute, which is a higher speed than the speed of the direct-current or universal tool with its large speed drop. This, of course, means more power with a given size of rotor.

Several factors governed the selection of a standard frequency for these tools. Since it was necessary to obtain spindle speeds for the drills, reamers and abrasive wheels which would be suitable for modern cutting tools, there must be a point where the reduction in weight of the motor consequent on higher frequencies would be more than offset by the greater weight of the gearing required to obtain the necessary spindle speeds. From this point of view, the desirable frequency was found to be in the neighbourhood of 180 cycles per second. Troubles in ball bearings and difficulty of lubrication at high speed are other limiting factors, although improvement in both directions indicates the possibility of still higher frequencies. Thus the high-frequency tools meet the requirements of intensified production in modern industry where portable tools are driven to the utmost and in many cases get very little care.

The adoption of this principle naturally involves the adoption of special plant for the production of the high-frequency current, as such a supply is not given by any public network. There are two well-known methods of transforming commercial current to high-frequency current, viz., the frequency converter and the motor generator.

The frequency converter can be used only when the primary current is alternating. As generally employed for operating high-frequency tools it consists of special windings in a slip-ring motor frame, the rotor of which is driven backward, usually by an induction or synchronous motor. In operating high-frequency tools, it has been customary, with a 60-cycle source of supply, to employ an 8-pole frequency converter, driven at 1800 revolutions per minute to furnish 180 cycles. The stator winding is excited with 60-cycle energy and the supply line for the tools is connected to the slip-rings. The field produced in the stator winding rotates in one direction at 900 revolutions per minute. The rotor is turned in the opposite direction at 1800 revolutions per minute, giving a net speed of 2700 revolutions per minute, which gives 180 cycles in the eight-pole rotor. As satisfactory tool operation depends on good voltage regulation, it has been the aim of the manufacturers to keep within 8 per cent. voltage variation, the full-load voltage being 220. The frequency converter has an inherent regulation and the voltage at a given load varies only with the primary voltage.

The motor generator or alternator provides an entirely new current, and at 1800 revolutions per minute a 12-pole generator will be required to produce 180 cycles. The motor can be operated from either direct current or alternating current. If the latter, an exciter will be required for the generator fields. A regulation not to exceed 8 per cent. is also desired with this set, but it is possible to vary the voltage either manually or automatically by changing the field current of the generator.

Each type has its advantages, and while the simplicity of the frequency converter appeals to many, the possibility of voltage regulation seems more important to others. The current used for high-frequency tools is three-phase and a cable with four conductors is provided with the tool, terminating in a suitable plug. The mechanical construction of these tools needs little comment, as, apart from the high speed of the rotor, the design follows orthodox principles.

ALLOY WELDING PROCESSES, LTD.

Besides electrodes of various types and suitable for all kinds and classes of arc welding, this firm, which, incidentally, has recently opened a new and

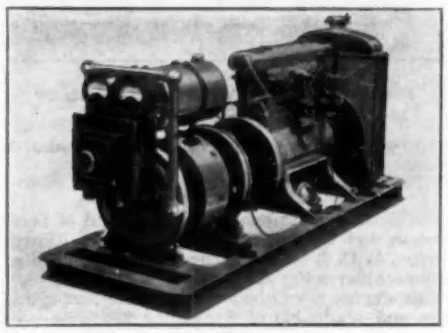


FIG. 37—ENGINE-DRIVEN WELDING SET—ALLOY PROCESSES

extensive factory at Forest-road, Walthamstow, is showing a number of interesting welding sets. The dynamos belonging to the D.C. outfits are built in accordance with the principle described in an article on a "New Welding Dynamo" published in THE ENGINEER of October 5th, 1928, and they may, of course, be driven by a belt, a small petrol engine—as shown in Fig. 37—or by an electric motor, as shown in Fig. 38. The portable engine driven set, shown in Fig. 37, only weighs 12 cwt., and as will be gathered from the illustration, it is very compact. The welding output of the motor generator set—Fig. 38—is

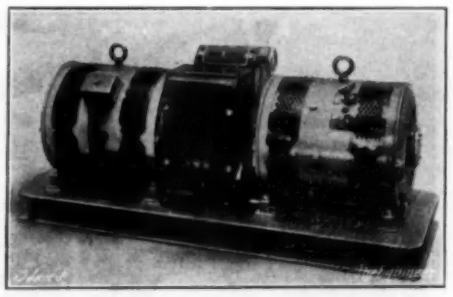


FIG. 38—MOTOR GENERATOR WELDING SET—ALLOY PROCESSES

6 kilowatts, and it is suitable for operating a single arc. By means of field control, the output can be varied from 50 to 200 ampères at 30 volts, rising to approximately 80 volts on open circuit. No separate resistances are required, the welding leads being taken direct from the machine terminals. The motor is a 12½ horse-power enclosed ventilated machine, which runs at approximately 1440 revolutions per minute. For a direct-current supply, it would be a D.C. shunt machine, whilst for an alternating-current supply a simple squirrel cage motor would be provided. A starter with no-volt and overload releases is fitted between the dynamo and motor, as shown. The shunt regulator for regulating the current of the arc from 50 to 200 ampères is also fitted between the motor and dynamo. With the machine a complete welder's equipment is supplied, comprising among other things an electrode holder, two screens with coloured glass, &c. Another machine exhibited is enclosed in a sheet-metal housing, as shown in Fig. 39. Other exhibits consist of a multi-operator machine, which can supply current for three operators, and static transformer welding plant. As regards the firm's welding electrodes, we have been asked to mention that from time to time manufacturers of stainless steels have consulted Alloy Welding Pro-

cesses, Ltd., concerning the welding of such steels, and in each case it has been possible to provide electrodes which gave entirely satisfactory results. At the present time no fewer than eighteen different

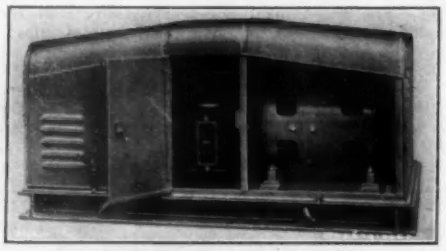


FIG. 39—ENCLOSED WELDING SET—ALLOY PROCESSES

types of stainless steel welding electrodes are made.

DAVEY, PAXMAN AND CO., LTD.

The most striking exhibit on the stand of Davey, Paxman and Co., Ltd., Aldwych House, Aldwych, London, W.C. 2, is an oil engine, of which we give an illustration in Fig. 40.

This engine, it will be seen, is of the four-cylinder type, and is capable of developing 250 horse-power continuously, or an overload of 290 H.P. for one hour. It is of the cold-starting type, which has already been described in THE ENGINEER, and is especially suitable for marine auxiliary work.

The design of these engines embodies the Blackstone patented "spring injection" system of fuel injection, which enables the injection to take place at the same pressure and exactly at the right moment whatever the speed of the engine. At the same time it avoids the necessity for either an air compressor or high-pressure fuel pump with long pipe connections under pressure. The Paxman excentric-operated exhaust valve gear, which is also incorporated, is continuously lubricated and quite silent in action. While this gear enables use to be made of the very

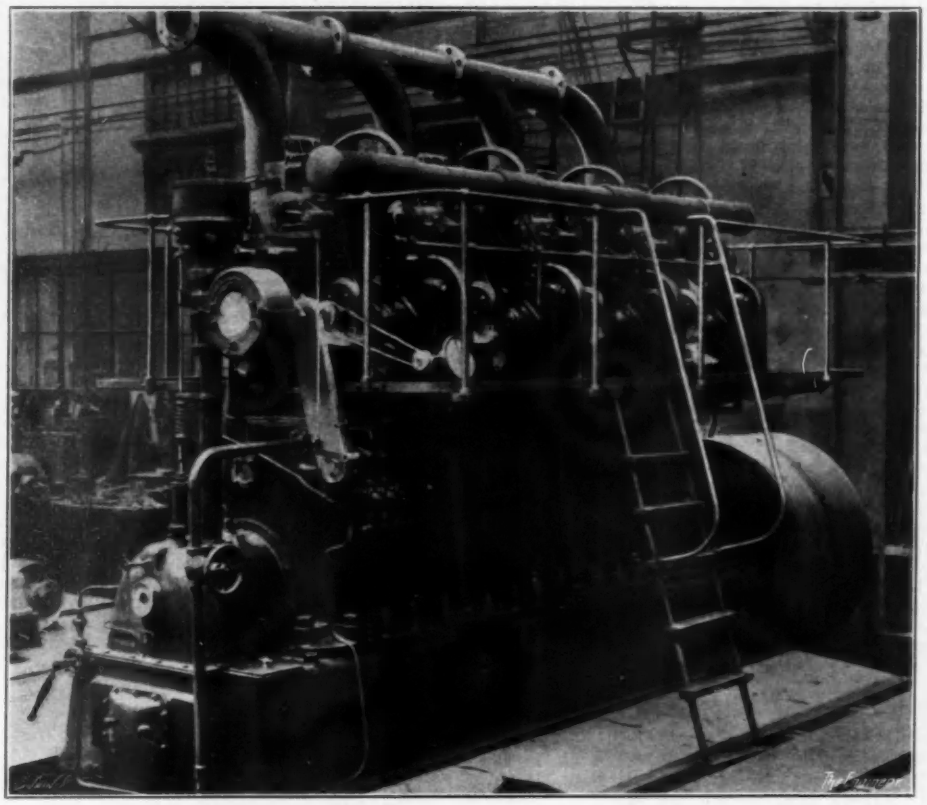


FIG. 40—COLD-STARTING 250 H.P. OIL ENGINE—DAVEY, PAXMAN

quickest lifts of the valve, it yet prevents any possibility of shock, thus lengthening the useful period of service before regrinding is necessary. The construction of the gear is such that removal of the valve is a very simple matter, there being no cotters or powerful springs to contend with.

The engine is totally enclosed and provided with forced lubrication throughout; the cam shaft is sheathed, and the governor, which is driven direct from the crank shaft, is continuously lubricated from the main oil system. The lubrication of all the main bearings is effected under pressure, which pressure is adjustable by hand control. A supply of oil is also taken to the vertical shaft bearings and gears. Duplicate filters of generous capacity are provided, and so arranged that either can be cleaned whilst the plant is in motion without disturbing the supply of oil. The exhaust manifolds are water-cooled, and thermometers fitted on each cylinder. The speed of the engine can be varied whilst running, either by the governor or by means of an independent hand control. It is noteworthy that the engine is capable of starting up against heavy torques, which makes it very suitable for coupling to compressors and electrical

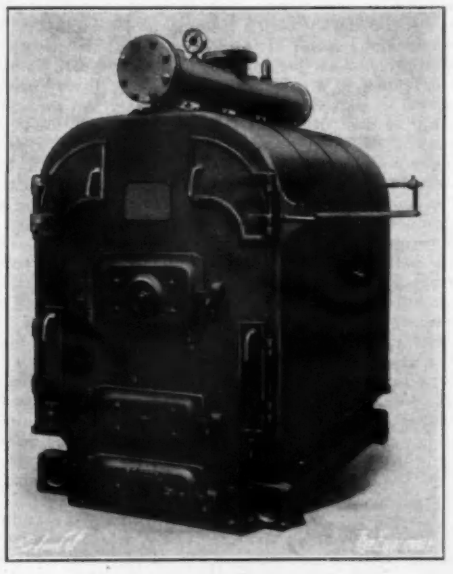


FIG. 41—LOW-PRESSURE BOILER—DAVEY, PAXMAN

auxiliary machinery of all types. Some separate parts of the engine are also exhibited, including a sectioned head completely fitted up with valves and their cam shaft, which can be operated by hand to demonstrate its working and the effectiveness of the spraying arrangements.

There is also, on this stand, an example of the low-pressure heating and steam-raising boilers, which this company has recently developed, one form of which is illustrated by our half-tone engraving, Fig. 41. These boilers are made entirely of wrought steel, with welded joints, and are consequently less liable to rupture than are the usual cast iron boilers used for such purposes. The boiler is made up of a series of short elements, each of which comprises two water-spaces, of horse-shoe, or arch form, with a flue space between the two arches. The inner arch of the assembled units forms the furnace and combustion chamber, while, by means of a few fire-brick baffles, the products of combustion are made to traverse the length of the boiler three times. For services where the water is in continuous circulation and there is consequently no fear of scale accumulating on the wet side of the heating surfaces, the boiler is completely boxed up, but the surfaces liable to the deposit of soot are readily accessible for cleaning. In the case of boilers which have to deal with the constant addition of feed-water, each section is provided with four cleaning doors, and, despite the apparent rather complex form of the elements, it is obvious that all their surfaces are accessible through these openings by means of properly shaped cleaning tools. The front and back sections of the boiler are arranged to take the fire-door, smoke-box, &c., and have water-cooled ends.

C. G. VOKES, LTD.

On the stand of C. G. Vokes, Ltd., of 95–97, Lower Richmond-road, Putney, S.W. 15, there is displayed a varied range of "Protectomotor" air filters of British manufacture, which are designed for use with motor car and lorry engines, gas and oil engines, air compressors, and pipe lines and industrial air filtration plants. We have chosen for description four examples of air filters of this special class which are used in general industrial work.

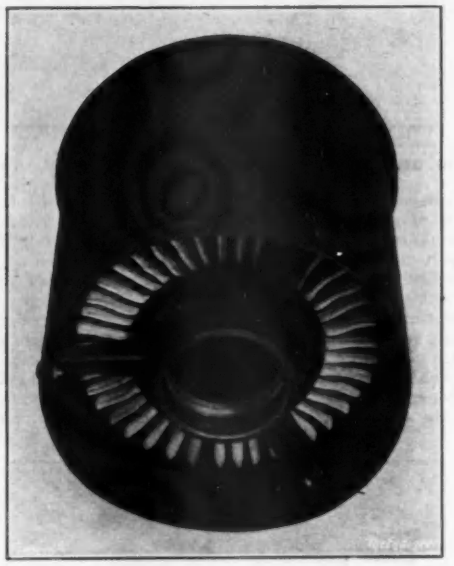


FIG. 42—INDUSTRIAL TYPE AIR FILTER—VOKES

In Fig 42 we show one of the larger sizes of "Protectomotor" filters which has a designed capacity of 220 to 300 cubic feet of air per minute. It is about 14in. in height, with a diameter of 13in., and the outlet connection is screwed for a 4in. pipe.

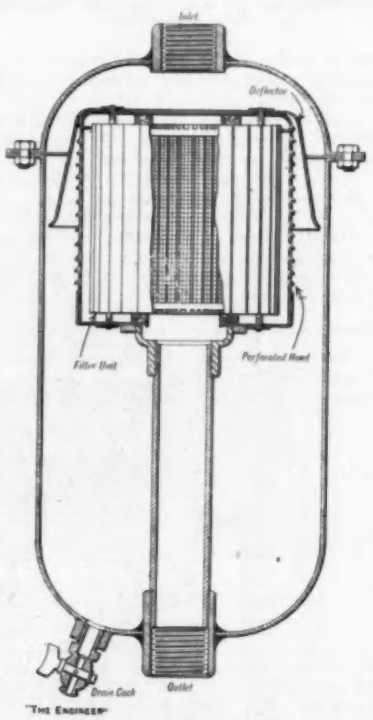


FIG. 43—FILTER FOR COMPRESSED AIR—VOKES

Such units are employed singly or in pairs on internal combustion engines and air compressors. It will be seen that the filtering medium consists of a special felt which is stretched over radial fins of wire gauze bent to form a series of pockets grouped symmetrically around the central outlet. The arrangement illustrated provides a very large filtering area which is compact in form and has a negligible resistance. About 20 square feet of felt is arranged in a volume of a little less than 1 cubic foot.

In the drawing Fig. 43 we show a similar type of filter arrangement within a steel container for use in compressed air pipe lines. In this case the filter is conveniently employed to remove dirt, moisture or oil from the air. Such a filter is particularly desirable in certain industrial processes in which supplies of pure air are required. The filter casing is designed to withstand a working pressure of 125 lb. per square inch and is placed vertically in the line of air piping. The air entering at the top of the filter passes down over the steel deflector shield and is thus thrown against the sides of the vessel. Most of the water, oil and dirt is carried by the entering velocity of the air to the bottom of the shell, from which point it can be blown off by the drain cock provided. The remaining impurities are dealt with by the filter unit which is housed in a light steel casing with a perforated exterior. By closing a valve in the air line

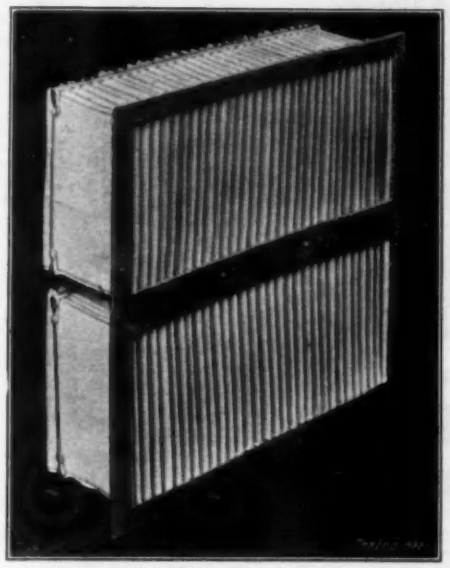


FIG. 44—PANEL TYPE FILTER—VOKES

and so shutting off the supply of air to the filter, and then opening the drain cock, it is possible to clean the filter by allowing the air on the outlet side of the filter and the pipe connections to blow back through the filter, thereby removing all material which may have gathered on the filtering surface. In the normal types of filter shown in Figs. 42–45 it is found that a small amount of vibration renders the filter units self-cleaning, although arrangements are usually made for cleaning by means of internal compressed air jets. In the case of very large installations specially designed vacuum cleaning plant is employed. Our engraving Fig. 44 shows a panel type filter unit in which the felt cells are formed in a series of parallel fins. The panels shown are each 19½in. square and they may be mounted on a 20in. by 20in. frame or may be curved to fit a cylindrical frame formed of channel iron. Each panel has a designed filtering capacity of 800 cubic feet of air per minute and the area of the filtering felt is about 60ft. In our issue of August 9th we described a factory air filtering installation of this particular type in which there were 108

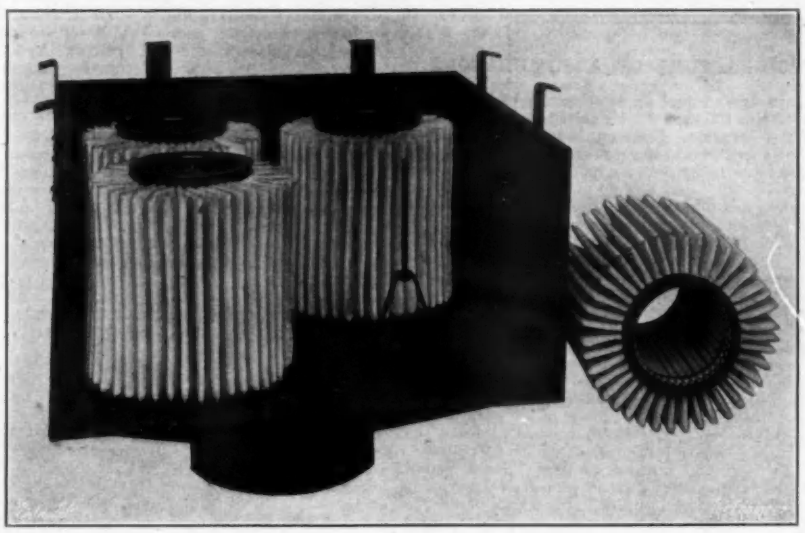


FIG. 45—FOUR-CELL INDUSTRIAL TYPE FILTER—VOKES

panels giving a total capacity of 86,400 cubic feet of air per minute. In this particular instance the filter was dealing with a considerable amount of dust, and it only required cleaning every two weeks, the operation occupying only 1½ hours. In Fig. 45 we show an industrial type of filter with multiple units of the circular pattern. The four-cell filter shown has a designed capacity of 1000 cubic feet of air per minute, and similar units can be constructed for duties up to 5000 cubic feet, arranged as either upright or hanging filters.

THE ELECTRO-MECHANICAL BRAKE COMPANY, LTD.

Air break pillar type starters for A.C. motors are exhibited by the Electro-Mechanical Brake Company, Ltd., of Cecil Chambers, 86, Strand, W.C. 2. The advantages claimed for these starters are (1) low maintenance, (2) ability to stand heavy overloads, and (3) absence of burnt contacts. In the case of oil-immersed starters, the makers explain, the contacts are liable to be burnt if the oil is allowed to become carbonised or if the oil level falls below the contacts. In the design of these air break starters, safety, ease of operation and efficient protection for the motor have been aimed at. Starters of this type have been designed for A.C. slip-ring motors, auto-synchronous motors, and for star-delta and auto-transformer controlled squirrel-cage motors, with outputs up to 250 horse-power. Ventilated, enclosed, dustproof, and explosion-proof enclosures are employed, according to circumstances. Various types of cable fittings and instruments are supplied. All the enclosures, with the exception of the explosion proof type, can be provided with a solid or wired glass-panelled door. The rotor starter is of the drum type, consisting of a heavy cast iron spider, ground to size and securely clamped to a steel shaft insulated with mecanite and provided with heavy hard-drawn copper contact segments. The hinged rotor starter fingers are provided with renewable tips, and compression springs keep the fingers in contact with the drum. The ratchet slow-motion operating gear which operates the starting drum, is designed so that the lever must be depressed until the last notch is reached, and in the event of the lever being released on any intermediate notch, the contactors immediately open and power cannot be supplied to the motor again until the starting drum has been brought back to the first position. Inching can be done by depressing and releasing the starting lever. When it is required to inch from a distance, push buttons are provided. As the circuit is made and broken on heavy triple-pole contactors, there is practically no wear and tear on the rotor drum. All the starters are fitted with three overload relays for overloads of 25, 50 and 100 per cent., but other settings can be arranged for. Time lags can also be fitted if necessary. In a separate locked chamber at the base of the starter there is a triple-pole isolating switch, which is mechanically interlocked with the rotor starter, so that the switch cannot be opened or closed unless the starter is in the "off" position. All the starters are provided with E.M.B. unbreakable and rustless grid type resistances.

The firm has also developed a range of steel-cased air-break pillar type starters for D.C. motors, up to 250 horse-power—see Figs. 47 and 48. They are suitable for shunt or compound-wound, constant and variable speed motors, and they may be provided with ventilated, enclosed, dustproof or explosion-proof enclosures, as in the case of the A.C. starters. Various types of cable fittings and instruments can be supplied. The operating gear and interlocks form a single unit, and the ratchet type slow-motion operating gear is arranged so that the lever must be kept depressed until the last notch is reached. What has been said in connection with the A.C. operating gear, contactors and overload relays, applies to the D.C. starters. The isolating switch in the case of the D.C.

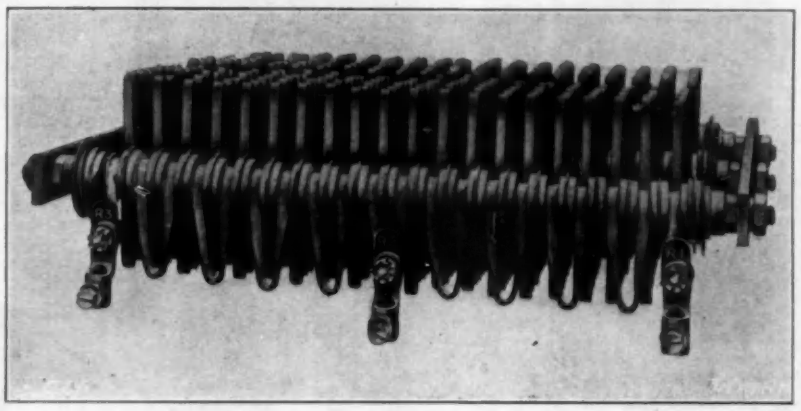


FIG. 46—UNBREAKABLE RESISTANCE UNIT—ELECTRO-MECHANICAL BRAKE CO.

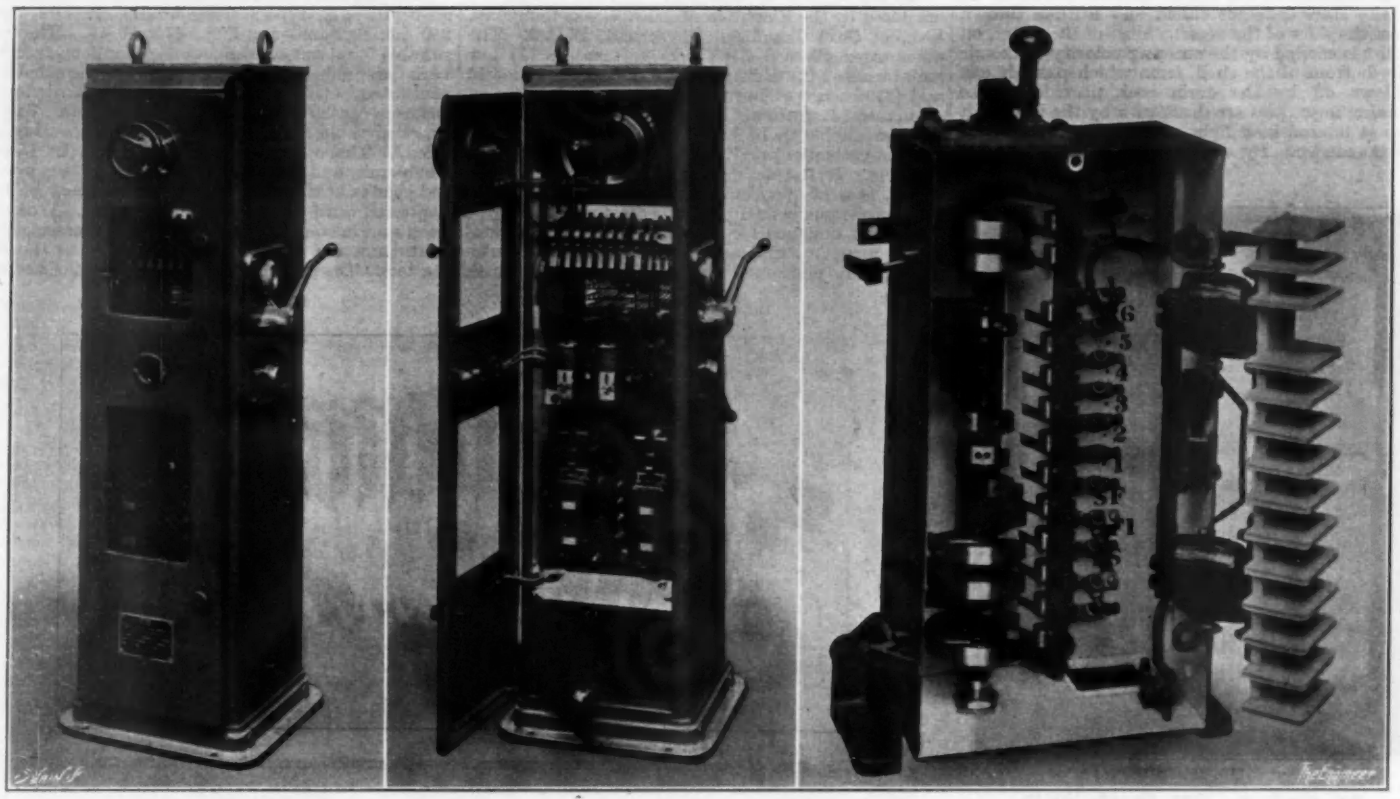
starters, however, is naturally of the double-pole type. Apart from the case, there are four complete units, viz., the controller pillar and isolator, the drum type starter, the operating gear, and the "E.M.B." resistance. Each unit can be removed as a whole, and it is unnecessary to interfere with any part of the pillar except that which has to be removed.

The firm's steel case controllers—Fig. 49—are also on view. These controllers are for general industrial purposes, and particular attention is drawn to the following features:—(1) The drum can be removed in a few minutes simply by slacking back four bolts in the cover plate, and as the cover plate is spigoted to the controller, the drum can be replaced or a new drum can be fitted without disturbing the alignment of the drum with the fingers; (2) the controllers are very conservatively rated, and can be depended upon to meet the requirements which purchasers specify; (3) the magnetic blow-out is very efficient; (4) ample space is provided for the cables, and arrangements can be made so that they can be brought in through the back, side or bottom of the controller, according to requirements; (5) the hinged fingers are of heavy construction, and are provided with compression springs which maintain them in contact with the drum; (6) the terminals are fitted with substantial hexagon-head screws instead with the usual small cheesehead steel screws; (7) the steel case ensures that the controllers are not damaged in transit; (8) the controller drum is held in position by substantial hinged quick-releasing catches, and is absolutely dustproof; (9) it is impossible for the handle to work loose.

The firm's unbreakable, jointless, and rustless resistance—shown in Fig. 46—scarcely needs description, as it is are well known to all electrical engineers. Briefly, each section is made in one continuous length of drawn material and the resistances are particularly suitable for use in places where bad vibration is experienced. They are largely used on cranes, furnace chargers, tramcars, and telphers. It is claimed that they do not deteriorate under the most severe conditions. As they are non-inductive, they are particularly suitable for use on A.C. circuits. For the same rating the weight is less than that of a resistance composed of cast grids. As the material is drawn, it has a uniform cross section and there is no fear of local heating. For the insulation of the grids mica and bakelite are used, and all the resistances are tested at an alternating-current pressure of 2500 volts between the grids before dispatch. For ordinary purposes the makers use a standard material having a temperature coefficient of 16 per cent. per degree Fahrenheit, against 11 per cent. for cast iron, but for special purposes grids are supplied which are composed of a copper-nickel alloy with a negligible temperature coefficient. The grading of these "E.M.B." resistances is a simple matter, as each grid forms an available tapping point and the terminals

can be attached without disturbing the grids. When desired, a terminal board can be mounted on the base of the resistance, an arrangement that is often desirable when cables enter at a definite position through pipes, glands and cable boxes. New grids can be put into position with very little trouble. The rating of the resistances naturally varies according to customers' requirements, but in all cases the resistances are calculated to ensure that the temperature does not exceed 290 deg. Cent., as laid down by the B.E.S.A. specifications. It is claimed that owing to the excellent radiating properties of these resistances, the cooling periods between each individual cycle of operations can be much less than that with other types of resistances. The standard ventilating covers for these resistances are composed of small mesh expanded metal, reinforced with a wide steel strip beading at the edges. Other covers are, however, supplied to meet special requirements.

(To be continued.)



FIGS. 47 TO 49—D.C. MOTOR STARTERS AND STEEL-CASED CONTROLLER—ELECTRO-MECHANICAL BRAKE CO.

The Visapur Lake and Canal.

ON August 26th his Excellency the Governor of Bombay, Sir Frederick Hugh Sykes, opened the Visapur artificial lake and canal system, which have been under construction for many years. The following account of the undertaking, based upon a report compiled by the Superintending Engineer, Central Circle, Poona, gives a good idea both of the history and importance of the works.

The south-eastern portion of the Ahmednagar district lies in the area of the Bombay Deccan, most liable to famine, and for many years schemes for the protection of this area engaged the attention of officers of the Revenue and Public Works Departments.

The valley of the Hanga River was investigated for possible sites for storage works in 1876–1877 during the great famine of that year, and various schemes were surveyed and reported on. Finally the Visapur site was selected, but it was not until the famine of 1896–1897, when it became imperative to undertake some large earthwork to provide relief for the famine-stricken people in the Shrigonda Taluka, that work on the scheme was begun. After the close of this work as a relief work in 1900 the Indian Government handed it over to the Jail Department for construction by the Deccan Gang, and for twenty-seven years it provided extra mural work for convicts. In 1927, when the Deccan Gang was moved to the new Central Prison at Nasik, the Government decided to push the work forward to completion, and to finish the construction of the left bank canal, which had been begun by famine labour in 1897. The dam was finally completed in 1927 and the canal with its branches and distributaries is now practically completed.

The scheme comprised the formation of a large lake and the cutting of a canal. The lake, which has a water spread of 2¼ square miles, is formed by an earthen dam 7440ft. in length with its crest 84ft. above the river bed. The dam is designed to store 1218 million cubic feet, of which 1136 million cubic feet will be available for irrigation, with a full supply level 72ft. above the river bed. A waste weir 1960ft. long is provided on the left flank of the dam. It is capable of discharging the maximum estimated run-off of 0·91in. on a catchment area of 159 square miles, equivalent to a discharge of 92,786 cusecs, with a depth of water 6ft. above the crest of the weir. Thus the dam will have a freeboard of 6ft. during the highest floods.

A masonry culvert 225ft. in length with its sill 30ft. above the bed of the river passes through the dam, and water is let into it through two gates 3ft. by 3ft. controlled from a tower built on the inner side of the dam. The culvert leads to the main basin from which the canal, controlled by two gates 6ft. by 5ft., takes off. A scouring sluice has been provided leading from the basin to an escape into the main nalla, through which any accumulation of silt at the inner end of the culvert can be scoured away. The canal, which is 11¼ miles long, is designed to discharge 110 cusecs at the head and 100 cusecs at the tail. Water is distributed to the fields through 35 miles of distributaries and minors and 157 miles of cultivators' channels, most of which have been constructed. The country through which the canal passes is much broken up, and this has necessitated the construction of (1) a 7ft. by 4ft. tunnel 1400ft. long, (2) several high banks and deep cuttings of which the maximums are 27·65ft. high and 31·10ft. deep respectively, and (3) twenty nalla crossings, the most important of which are Aqueduct No. 1 in the first mile of the canal, and Aqueduct No. 2 in the fourth mile.

The canal has been designed to irrigate some 13,000 acres in the rabi season, out of a gross command of 95,000 acres, and for the present is intended to be used as a protective work, *i.e.*, no perennial irrigation will be allowed, but any surplus storage at the end of the rabi season may be used for the cultivation of fodder crops, for which there will probably be a large demand when the cultivators realise the advantage of keeping their cattle in good condition during the hot weather.

THE MANUFACTURE OF ACCUMULATORS.

A FEW days ago we had an opportunity of inspecting the works of the Chloride Electrical Storage Company, Ltd., at Clifton Junction. Since our last visit some four or five years ago there have been great developments at these works, which have grown amazingly. The company owns some 37 acres of land, and a large portion of this area is now covered by buildings of modern character, while the number of persons employed is over two thousand. It is claimed, in fact, that these are the largest works of the kind in the British Empire. The company manufactures the well-known Exide batteries for motor cars and wireless installations as well as accumulators of all sizes and designs from hand lamp examples to the large patterns used in submarines and central power stations. Essentially these accumulators are all of the lead-acid type, and consist of plates or grids holding lead oxides which are immersed in sulphuric acid. The chief points of difference in the various types of batteries manufactured lie in the design of the plates, some of which are made of antimonial lead and others of pure lead, while in the ironclad batteries the positive plate consists of a number of vertical "pencils" joined at the top and bottom to bars. Each pencil contains a core surrounded by the active material, peroxide of lead, and this is enclosed by a cylindrical tube of ebonite having horizontal slits, which allow the electrolyte access to the active material while being still fine enough to retain the active material in position. Each tube has two vertical ribs projecting on opposite sides at right angles to the face of the plate, and these ribs act as supports and insulating spacers, which permit the use of plain wooden diaphragm separators. For submarine purposes each boat requires about 125 tons of these batteries.

We were particularly impressed by the welfare side of the works. The healthy appearance of the workers is a splendid testimonial to those who have charge of this department. We did not require to be informed that the health and welfare of the workers was the company's first consideration. The provisions made for the workers' well-being include a sick club, annual holiday with pay; library; recreation club with tennis, bowls, cricket and football; long service gifts; employees' benefit fund; pension scheme; evening classes, &c.

A "trainee" scheme is in operation, which gives youths entering the company's service an opportunity of obtaining an all-round knowledge of the various branches. Youths of good education who have matriculated enter the employ of the company under this scheme, and are moved through the various departments. Their progress is noted, and, where a bent for a particular class of work is discovered effort is made to develop it. We were told that this scheme is very successful.

THE TRAINING OF MANAGERS.

THE department of Industrial Administration of the Manchester Municipal College of Technology, which was established in 1918 by a group of prominent employers in the district with the co-operation of the governing body of the college, has to do with the scientific training of managers. Courses in factory costing, accounting, economics, and similar subjects are included in the curriculum. The department offers instruction to students from other educational institutions in three different grades. To graduates of approved universities it offers a one-year post graduate course; to students of matriculation standard it offers a two-years' course; and to students already engaged in industry it offers facilities for part-time or evening study. In addition, students who may not be able to qualify for admission to the certificate courses may be admitted as special students. The department aims at identifying itself closely with the industrial life of the community in the belief that in this way it will be able to render a good service, both to its students and to the business world. It has been fortunate in securing the active support of the industrial community, and by means of a programme of visits to places of business gives its students opportunity to investigate at first hand actual problems. So far, it is stated, the students in this department have had no difficulty in securing suitable appointments.

IN California there has been established an experimental plant for the investigation of the effects of earthquake shocks on buildings, of which the following particulars are given by the *Engineering News-Record*:—It comprises a platform of I-beams bolted and welded together, about 10ft. by 12ft., weighing 6000 lb., or with attachments about 8000 lb. It rests by ball bearings on four railway wheels ground to true circular form, placed on short lengths of rail. Three helical springs with stiffness of 4000 lb. per inch, anchored to concrete piers, cushion the longitudinal motion of the table. Two forms of drive are provided. In order to produce undamped harmonic motion, a vertical fly-wheel with adjustable unbalance, belt driven by an electric motor, can be mounted rigidly on the table. For producing damped vibrations set up by a sudden force application, there is an 1100 lb. pendulum 17ft. long, arranged to strike a bumper spring fastened to one end of the table.

Railway and Road Matters.

THE King has approved the appointment of Mr. William Leach, and Mr. Frank Wallis Galton, as members of the Royal Commission on Transport, to fill the vacancies created by the resignation of Mr. Frederick Montague and Mr. Walter Robert Smith.

THERE have been some minor accidents of late. On Friday, the 13th, there was a buffer stop collision at Lime-street Station, Liverpool, and on the evening of the same day a passenger train was derailed at Harrow, on the Metropolitan Railway. On Saturday, 14th, a passenger train and a train of empty carriages were in collision at Glasgow, Central.

THE Ministry of Transport Railway Returns for 1928 have now been issued as a Stationery Office publication, price £1. These returns give particulars of the capital authorised, raised and expended, and the receipts and expenditure of the companies on the railways and auxiliary undertakings, the length of track, amount of rolling-stock and other general information.

WE regret to hear that Mr. James Fraser has felt compelled, owing to ill-health, to resign his position of chief commissioner of the New South Wales Government Railways, which position he has held since 1917, having at one time previously been the chief engineer for seven years. It may be remembered that Sir Sam Fay and Sir Vincent Raven formed a Royal Commission to inquire into the management and working of those railways, and their report, which was reviewed in THE ENGINEER of December 26th, 1924, was a complete vindication of Mr. Fraser's administration.

THE complete blockage of the Callandar and Oban line, between Callander and Strathyre, the other day, owing to a big fall of rock, reminds us that on the same line there was provided, some fifty years ago, an arrangement of fixed signals which would warn drivers if the line was obstructed by fallen rock. The signals, which are still in use, were provided where the Oban line passes through the Pass of Brander at the foot of Ben Cruachan and on the edge of Loch Awe. The signals stand normally "off" and have weights, which are attached to wires running by the side of the line, and so arranged that should a big stone fall the wires would be broken and the signals would, by the weights on them, be thrown to "danger." In the *Great Western Railway Magazine* for October, 1928, reference was made to the provision of similar signals on the Eastern and Church Hope Railway.

IN the *Manchester Guardian* of September 10th appeared a letter on the wagon question from Mr. Philip Gee, to which a reply appeared as a footnote. In the latter there was a statement which, in view of the high standing of our contemporary, should, we consider, at once be corrected. The statement in question was that "there are upwards of 200,000 privately-owned wagons in general merchandise service." Reference, however, to the Board of Trade census of railway wagons of August, 1918, shows, on page 5, that there were then 626,223 private traders' wagons registered to run on railway companies' lines and 91,460 standard gauge wagons that were not allowed on these lines. On page 23 particulars were given as to the principal classes of traffic carried in the 626,223 wagons, but general merchandise is not mentioned. Moreover, the ownership does not include any traders except colliery proprietors, coal factors, coal merchants, and coal distributors, mine and quarry owners and oil distributors.

THE *Railway Newsletter* for September contains a picture of one of the new standard signals adopted by British railways. In these the arms rise to 45 deg. above the horizontal when a "clear" indication has to be given. As regards the signal indication that is no improvement; in fact, in many cases, conditions will be worse, as an arm in the "off" position will not be as readily seen through an overbridge. The benefit lies in the fact that should a connection fail when the signal is at "clear" the arm will fall to "danger" by its own weight, with the further advantage that balance weights on the lever at the foot of the signal are only necessary to keep a tight wire, and that the spectacle frames which carry the red and green, or yellow and green, glasses, and which also act as a counterbalance, may be lighter. In justice to Charles Hutton Gregory, who introduced the railway semaphore in 1842, and to the older generation of signal engineers, it must be remembered that when the railway "policeman" had to indicate a clear road he kept his arms by his side. The upper quadrant movement was an institution on the railways of Germany, Belgium and Holland long before it was adopted in the United States. It was used in South Africa in 1902, and was first tried in this country by the Metropolitan Railway Company at Aldgate in 1909, and later became that company's standard.

As recorded in the article on the railway accidents of last year, which appeared in THE ENGINEER of September 6th, one of the satisfactory features of that year's working was the reduction in the number of coupling failures. Instead of 10,000 to 11,000 there were only 7760, which figure was even less than the 7905 of the coal stoppage year of 1926. A comparison with the figures for 1927 shows that there was a gratifying improvement as regards the couplings of passenger stock; breakages of coupling links fell from 571 to 475, and the breakages of screw shackles from 345 to 277. In goods stock the pulling out or breakage of drawbars or hooks decreased from 4604 to 3488, and the cases of uncoupling fell from 1017 to 697. It is remarked in Colonel Mount's report that the chief liability to failure is to be found in weakness of drawgear. That was responsible for 95·3 per cent. of the failures in passenger stock in 1927, and 94·5 per cent. in 1928, and of 86·4 per cent. of the failures in goods stock in 1927, and 88·3 per cent. in 1928. There was an increase, when compared with 1927, in the percentage of coupling failures in double-headed trains. With passenger trains the percentage rose from 13·3 to 14·26, and with freight trains from 9·9 to 10·39. The number of collisions and derailments resulting from all classes of coupling failure fell from 61 to 50; 10 of the former and 8 of the latter were double-headed trains. The liability to accident as a result of the division of goods trains rose from 0·71 per cent. in 1927 to 0·82 in 1928.

Notes and Memoranda.

ACCORDING to Dr. P. A. Wagner, the extent of the prehistoric mining operations carried out in South Africa is far greater than has generally been estimated. He thinks that at least 60 million pounds worth of gold—at present prices—was extracted from Rhodesia, that at least a million tons of copper was won, and that the output of tin was of the order of from 2000 to 3000 tons.

IT is announced that the Westinghouse Company, of America, has developed a new metal known as "Konel," which is credited with being much stronger than other metals at high temperatures, and can be used extensively in the moving parts of internal-combustion engines and in other hot places. The new metal is harder to forge than steel, and very tough at high temperatures. It costs only a few dollars a pound.

IN a recent issue of *Chemistry and Industry* Mr. J. S. Miller contributes an interesting illustrated article on the production and refining of native asphalt. The lake at Trinidad is probably the crater of an extinct mud volcano. The asphalt is dug out with mattocks, refined by heating to drive off the water which it contains, and then drawn off into barrels. It may be "fluxed" by mixing with petroleum residue to make it suitable for road work, refined asphalt being too hard for this purpose. All asphalts contain sulphur in a combined condition, and sometimes an asphalt is heated with sulphur to remove some hydrogen as hydrogen sulphide. This sulphur treatment raises the melting-point and lowers the ductility. The article indicates that the chemical composition of asphalt and even its physical properties are still only imperfectly known.

A THEORY evolved by Mr. R. R. Bottoms, of Louisville, Ky., is that the original source of helium is the basal crystalline rocks underlying the sedimentary deposits, and that the helium with large amounts of nitrogen and carbon dioxide in the granite seeps into the sedimentary deposits through fissures, crevices, and fractures in the basal rocks and diffuses and migrates through the structural rocks until it is trapped underneath an impervious cap rock in anticlinal folds or domes. Whether the helium in the granite rocks is primordial helium or results from radio-active disintegration of uranium, radium, and thorium, makes little difference. If this theory is correct, then we should feel more certain of finding helium in the vicinity of major granite uplifts or folds, especially if faulted, and in the vicinity of other volcanic activity which would tend to open up passageways for helium from the interior of the earth.

AMONG some recommendations concerning the control of traffic by light signals, which have just been issued by the Ministry of Transport, there are the following suggestions:—When a system of control signals is in operation pedestrians should be encouraged to cross the carriageway under the care of the signals and at the points where such signals are erected and at none other. The indiscriminate crossing of the carriageway by pedestrians is a potent cause of accidents both to pedestrians and to vehicles. For this reason it may be found advisable, on main thoroughfares where there is a considerable distance between any two inter-sections, to break up the traffic stream between the intersections by the erection of an additional signal, thereby affording pedestrians an additional opportunity to cross. All coloured lights and coloured objects capable of reflecting light which are liable to be mistaken for traffic signals should be removed from the vicinity of the signals or the line of sight on which they appear to approaching vehicles.

DISCUSSING the advisability of extending the very high buildings so popular in America, Mr. N. Cauchin, of Ottawa, says:—"The distribution of a moving population is subject to four dimensions; the width of its channels of communication, the height of the street load (i.e., of the building reservoir level of outflow or inflow), the length of street (resistance to the cumulative pressure of a long line of flow), and finally the time factor (the speed at which, given the three other dimensions, the fulness of the street can be poured out so to speak). In considering the gathering or the distribution of a city's population from and to its population shed, one must think and plan organically in terms of time-distance and not in separate factors of time and of distance, if one would sense and obtain an equivalence of distribution free from congestion and delays. The hexagon is the only geometrical figure which will accommodate the indefinite repetition in a continuous pattern of three-way junctions, without interstitial loss. To obtain the intrinsic health benefits from the hexagonal block for housing, it must be pointed north. It thus approximates the economic virtues of the circle and the constructional advantages of straight lines."

MUSEUMS, says *Nature*, need not be mere storehouses of inanimate objects; a thoughtful staff can do much to build around the specimens in their care the reflection of a human setting, thus enabling the significance of the exhibits to be appreciated by an ever-widening circle of interested visitors. An example of such treatment is afforded by the recently issued handbook of the collections in the Science Museum, South Kensington, illustrating industrial chemistry (London: H.M. Stationery Office, price 1s. net). This volume, although containing a descriptive catalogue of the collections, differs from previous catalogues in that considerably more than half the book is devoted to illustrations of the development which has taken place in that branch of science. Hence there is provided a background of human interest against which the exhibits themselves may be studied, and some idea of the course of evolution of a great modern industry may be gained. The museum authorities, and in particular the compiler, Mr. A. Barclay, are to be congratulated on producing a handbook which is not unworthy of a permanent place in any library of historical chemistry. The scene surveyed is, of course, so wide in its extent and so varied in its aspects that even the principal portions of it can receive but brief treatment and incomplete illustration. That such should inevitably be the case detracts in no way from the advantage of the method of presentation adopted or from the interest of the exhibits—nearly one hundred—which are to be found in Gallery LXVI. of the Science Museum.

Miscellanea.

A PNEUMATIC coal-cleaning plant, with a capacity of 80 tons per hour, is being supplied to the Bolsover Colliery by the Birtley Iron Company, Ltd.

A DEPOSIT of graphite has been discovered in the Bethang district of South-West Africa. The material is of a crystalline nature, and occurs in a bed of gneiss.

A BRIDGE 6 miles long is to be constructed between the islands of Zealand and Funen, Denmark, with the object of completing the connection between Copenhagen and the mainland.

TRIALS with the Flodin method for the electrical production of forgeable iron direct from the ore have been continued at the Laanghyttan works belonging to the Fagersta combine, and, according to the Stockholm *Dagblad*, very good results have been obtained. The method is said to be technically quite practicable and the quality of the iron produced good.

ACCORDING to *Indian Engineering*, the gradual rising of the bed of the Cauvery has resulted in the minor irrigation channels being blocked up and lands in some places covered with sand. To deepen the river bed so as to ensure a regulated supply of water to the lands and prevent them from being covered with sand again, a Re-modelling Division has been opened at Kumbakonam.

AN order for a chain which will weigh 60 tons, to be used to strengthen the dome of St. Paul's Cathedral, has been placed with Brown, Bayley's Steel Works, Ltd., Sheffield. Last year the same firm manufactured a stainless steel chain weighing 30 tons, 450ft. in length, which has been used in the strengthening of the dome. The new chain, which will be longer, will be used in another part of the dome.

THE monthly return made by the National Federation of Iron and Steel Manufacturers shows that the number of furnaces in blast at the end of August was 170, a net increase of three since the beginning of the month, six furnaces having been blown in and three having ceased operations. The production of pig iron in August amounted to 682,000 tons, compared with 671,900 tons in July and 519,000 tons in August, 1928; the production includes 206,900 tons of hematite, 280,100 tons of basic, 140,200 tons of foundry, and 26,700 tons of forge pig iron. The August output of steel ingots and castings amounted to 753,300 tons, compared with 804,800 tons in July and 648,300 tons in August, 1928.

THE aerial ropeway connecting the New Amianthus asbestos mine with Elandshoek Station on the Pretoria–Delogoa Bay main line, is now, says the *South African Mining and Engineering Journal*, in regular commercial operation. This ropeway is about 6 miles long. Its operation will greatly cheapen the cost of placing the Amianthus output on rail and will therefore assist in expanding the output, as fibre of lower grades which it would not previously pay to ship, will now be a commercial proposition. Moreover, with this reliable means of transport available, there is no doubt that an effort will be made to increase the output of all grades, thereby making maximum use of the ropeway and securing the best possible financial results all round.

TWO special alloys of great hardness are being manufactured in commercial quantities at the present time by the Commercial Alloy Corporation, of San Francisco, Calif., and marketed under the name of Cristite Series 1 and Cristite Series 3. Cristite Series 1 shows a hardness on the Rockwell C scale of 61 to 67, while Cristite Series 3 shows a hardness of 49 to 55. Both of these alloys can be easily deposited on a steel surface by means of ordinary welding equipment and are manufactured in the form of rods for this purpose. Cristite Series 1 is being used for facing earth-boring tools, for aeroplane valves, for aeroplane tail skids and for facing hammers of grinding and crushing equipment. The Series 3 alloy is being used for hard facing of stamp mills, railway crossings, &c. It withstands impacts much better than Series 1, which contains tungsten and is more brittle.

TEST studies to determine the effect of notches on fatigue failures will soon be started by the metallurgical division of the American Bureau of Standards. The Bureau was among the first to investigate fatigue of metals and to demonstrate that the cause is not crystallisation, as had formerly been supposed. Among the known causes, it is generally realised that sharp notches or re-entrant angles, such as keyways, screw threads or even stamped numerals, or surface scratches often cause failures in moving parts. Such notches serve as nuclei about which stresses are concentrated to the extent that progressive rupture of the metal occurs with continued motion of the part. In the tests, specimens will be made up of numerous types of steel under different heat treatments. Studies of non-ferrous metals will come later. The effect of different coating and plating methods on fatigue failures also will be considered.

THE modern method of relief map making, as used in the Topographical Survey at Ottawa, is to build an original model of sufficient successive layers of cardboard cut to conform to the lie of the ground to give the desired scale. They are attached to one another with rubber cement. Thus with paper one-twentieth of an inch thick and a separate sheet used for each 50ft. contour, 1in. of elevation on a model represents 1000ft. on the ground. These layers are built on a flat base. The whole structure then has a "stepped" appearance. To make it more natural it is graded or sloped off, using hot wax to fill the interstices. From the model a mould is made with plaster of Paris, and this mould is used in making replicas of the map. When the cast from such a mould is smoothed off, the next operation is to paste a topographical map in colours on the model. This constitutes the most difficult part of the process on account of the fact that paper when wet stretches in length sometimes 4 to 6 per cent., whereas its breadth may not vary more than a fraction of 1 per cent. In this process the map paper has to be carefully manipulated so as to occupy its proper position on the model. The model with the map paper superimposed is then varnished to preserve the paper and is placed in a glass-covered frame to keep it clean and protect it from injury.

BROOKMAN'S PARK WIRELESS BROADCASTING STATION

(*For description see page 295*)

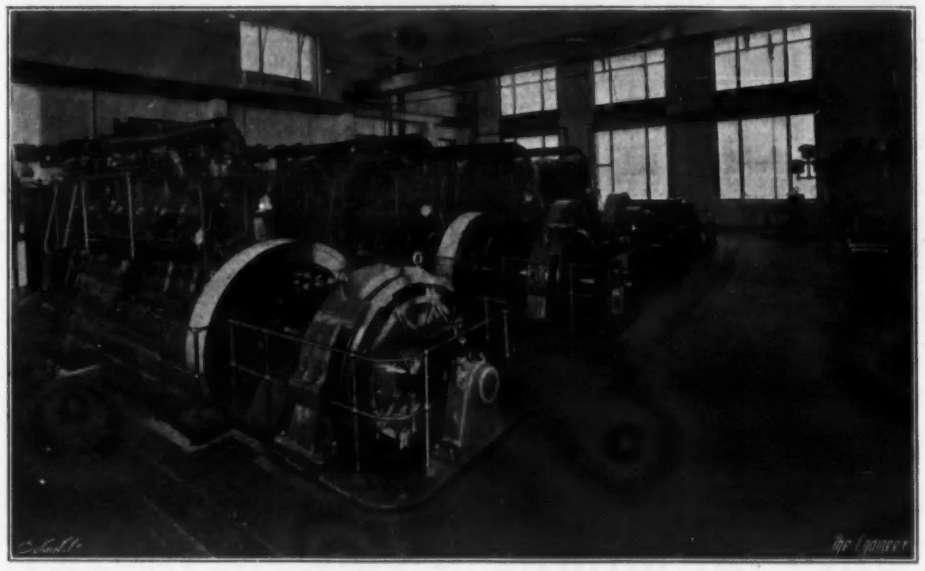


FIG. 1—GENERAL VIEW OF POWER HOUSE

FIG. 2—12,000-VOLT D.C. MOTOR GENERATORS

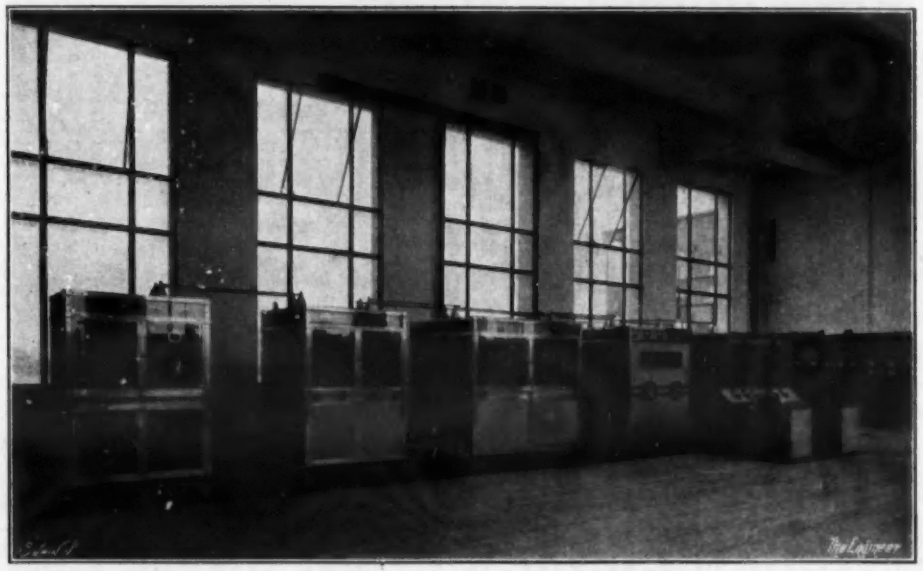


FIG. 3—ONE TRANSMITTER AND PART OF MAIN SWITCHBOARD

FIG. 4—SMALL MOTOR GENERATORS FOR GRID NEGATIVE VOLTAGES, ETC.

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THE ENGINEER.

SEPTEMBER 20, 1929.

Naval Disarmament: The Latest Phase.

A SEMI-OFFICIAL statement on the progress of the naval conversations between London and Washington, which was published on Tuesday, contained news of the first importance. In the course of these discussions every aspect of the naval problem has come under review, and with the exception of a single point the two Governments have arrived at a complete understanding. They are in full agreement on such subjects as the replacement of capital ship tonnage and relative strength in destroyers and other auxiliary craft. Both are pledged to secure, if possible, the elimination of the submarine, or, failing that, the reduction of submarine tonnage to the lowest feasible figure The sole question outstanding concerns the future establishment of cruisers, which has all along been the only serious point at issue. Even on this point an agreement may be said to be in sight, thanks to a remarkable concession offered by the British Government after consultation with the Admiralty. As recently as the summer of 1927 our cruiser requirements were estimated to be seventy ships with an aggregate of 490,000 tons. This was the figure we put forward at the Geneva Three-Power Conference as our irreducible minimum, and to those conversant with the world-wide commitments of the British Navy it did not appear to be an excessive one. The United States, however, declined to accept this figure, but was understood to be willing to compromise on a basis of something like 400,000 tons. Nothing came of the Geneva negotiations, and it seemed as if a complete deadlock had been reached. Meanwhile our relations with the United States were not improved by the widespread "big-navy" propaganda which was launched in that country immediately after the failure at Geneva. That sinister agencies were partly responsible for this movement has now been revealed by an action in the American courts which promises interesting developments.

It is now known that the late Government had devoted a great deal of thought to the naval problem and had drafted certain amended proposals which it intended in due course to submit to Washington. In consequence of the General Election, however, this task has devolved upon Mr. Ramsay MacDonald and his colleagues. We do not know, probably we shall never know, how the naval reduction programme of the last Government compares with that of the present administration, but we should not be surprised to find the two sets of proposals more or less identical. What really matters is that, after full consideration of the strategic needs of the Empire, present and prospective, the Admiralty has consented to reduce our original cruiser demands by more than one-third, and is now ready to accept a maximum establishment of fifty cruisers with a tonnage of 339,000 tons. Since the naval advisers of the Government judge this force to be adequate, it will, no doubt, be accepted by the Empire at large, but only on the assumption that peace at sea is reasonably assured for a long term of years. Of the fifty cruisers it is proposed that fifteen shall be ships mounting 8in. guns, the remainder being light vessels armed with 6in. guns. The United States, on the other hand, wants a total of thirty-six cruisers, including twenty-one with 8in. guns, the suggested aggregate being 315,000 tons. The British Government has urged Washington to reduce the number of 8in. cruisers to eighteen, not because an American preponderance in heavily gunned ships would cause alarm in this country, but because the building of twenty-one heavy American cruisers might impel other Powers to build more ships of that class, in which case our own policy of construction would have to be revised. It cannot be said, however, that a difference of opinion involving only three ships and a tonnage of 30,000 tons presents a serious obstacle to agreement. The difficulty, such as it is, will almost certainly be overcome when, and probably before, the next naval conference meets. With so obvious a determination on both sides to achieve a settlement this temporary hitch in regard to the distribution of cruiser tonnage need occasion no concern. On examining the proposed figures they will be found to correspond very closely to the respective building programmes of Great Britain and the United States. Including ships of the Royal Australian Navy—and for the purpose of these negotiations the Empire is counted as a unit—we have, up to now, completed or started work on thirteen cruisers of 10,000 tons and two of 8400 tons, all carrying 8in. guns. The United States has, actually building, eight 10,000-ton vessels, with fifteen more authorised for construction during the next three years. Should the British proposals be accepted, five of the projected American ships will have to be dropped. If, on the other hand, the Washington claim to twenty-one 10,000-ton cruisers be conceded, only two of these ships must be sacrificed. On whatever basis the final agreement is reached, the United States in its pursuit of parity will find itself compelled to complete the majority of its projected cruisers. This necessity, we are told, is repugnant to the American Government, but obviously there is no alternative. The hope expressed by certain American critics that parity might be attained by the wholesale scrapping of British cruisers was chimerical, ignoring as it did the actualities of the naval situation. When all is said and done the naval requirements of the British Empire are incomparably greater and more vital than those of the United States. In its desire to promote cordial relations with the American nation the British Government has not unduly stressed that truth. For the cause of friendship and goodwill the Empire is prepared to make a great sacrifice, but to ask that we, whose existence literally depends on the security of the sea routes, should so weaken our Navy as to render it incapable of performing its prime function is to ask too much. We hope and believe that the Government will under no circumstances consider any reduction of our future cruiser fleet. Fifty ships are few enough to patrol communications extending to 80,000 miles. Any proposal to go below that very modest establishment would be resisted by public opinion, which is never so strongly expressed as when attempts are made to tamper with the naval defences of the Empire. It is hardly necessary to point out that a naval reduction agreement on the principles suggested by the Government would have the effect of cancelling what remains of the cruiser programme authorised by Parliament four years ago. Of the sixteen cruisers provided for by that measure only eight have been laid down up to the present, and it is now extremely improbable that any of the remaining vessels will be started. As the contracts for their construction and equipment would have represented a value of not less than £16,000,000, it will be seen that naval disarmament is about to inflict another very severe blow on our heavy industries. Some consolation

is afforded by the reflection that a new treaty regulating the dimensions of the British Navy for many years to come will enable the Admiralty to frame a definite shipbuilding policy for the future, and both Government and private shipyards will therefore be in a better position to estimate their chances of work, so far as warship construction is concerned. In this connection we await with interest the revelation of the Government's plans for providing the Royal dockyards with alternative employment to obviate the necessity of wholesale discharges. The redundancy of labour at Devonport, Portsmouth and Chatham, already very marked, is likely to become still more pronounced in the near future, though the impending transfer of four battleships of the Mediterranean Fleet to the Atlantic command may serve as a palliative. We may add, however, that the country is neither in the financial position nor the mood to maintain indefinitely the *personnel* of the Royal yards at the present inflated figure, which bears no rational proportion to the needs of the fleet.

In the authoritative *résumé* of the naval discussions to which we have alluded, it is very aptly pointed out that a final agreement on limitation is dependent upon the adherence of Japan, France, and Italy. An agreement between Great Britain and the United States alone would have little practical value. We are inclined to attach small importance to the common desire of these two Powers to suppress the submarine. France, which has legislated for ninety new submarines, is not at all likely to surrender the naval weapon in which she reposes most confidence, nor does Japan, with seventy under-water craft and a definite preponderance in the heavy ocean-going type, show any enthusiasm for their abolition. Moreover, both these Powers, not to mention Italy, have in hand formidable programmes of cruiser and destroyer construction. A great deal has been heard about the "yardstick" by which the future strength of the British and American navies is to be dimensioned, but unless this implement can be applied to the other three major fleets of the world its utility is questionable. For this reason we welcome the British Government's decision that the next naval conference must embrace all the five Powers that attended the Washington gathering eight years ago. To attempt to make naval disarmament a "family affair" between the two English-speaking nations would be to invite disappointment and possible disaster.

Electrical Installations.

FOR many years the shoddy electrical contractor has been an intolerable pest. His incompetence and negligence have caused no end of trouble to people who have employed him. His ignorance has probably been responsible for many fires. But because he does his jobs a little cheaper than others, he continues to secure work and to inflict hardship upon the misguided public. All sorts of people call themselves electrical contractors or electrical engineers. Many originally engaged in totally different kinds of business, and in some cases no particular business at all, have drifted into the wiring branch of the electrical industry. Since the war the number of recruits has increased considerably. With the advent of broadcasting, moreover, it has become common for amateurs to meddle with electrical installations; in fact, in these days there are few households without someone who considers himself competent to do electrical jobs. Troubles with electrical installations are, therefore, scarcely to be wondered at. The only wonder is that they are not more frequent. This state of affairs is obviously bad for the electrical industry; it is also very disheartening to the genuine electrical contractor, who is anxious to put in good equipment and to make his work sound and reliable. If someone happens to receive a fatal shock, or a disastrous fire is traced to the electrical installation, the idea gets abroad that electricity is unsafe. The shoddy contractor or meddling amateur is rarely blamed. Few save those who understand the wiring business realise that if the installation work had been properly carried out or if it had not been meddled with in all probability the calamity would never have occurred.

The more electricity is used the more essential will it become to put a stop to the activities of these incompetent and mischievous people. We are all living in hard times; taxation is heavy; prices are high; money is scarce. Hence there is a very natural temptation to accept the lowest price. But as far as electrical work is concerned, the lowest tender may easily prove to be the highest in the long run. Repairs and replacements may very soon wipe out any saving on the initial cost; repairs and replacements are, in fact, what shoddy contractors rely upon for their livelihood. What applies to private houses, applies also to works. Nothing is more essential in connection with the electrification of a factory than thoroughly good and sound work. For years competent and conscientious people who study the welfare of the electrical industry as much, if not more, than their own personal interests, have protested against the tactics of these unqualified and unscrupulous contractors who engage in shoddy work. Yet the business goes on. Possibly, however, a small book recently published by the Electrical Contractors' Association on "Electrical Security" will help to mitigate the trouble. In some respects it is, perhaps, rather unnecessarily censorious, but a little exuberance may be excused when the object is to force home an important truth. With all the dodges that are adopted in order to save expense, we cannot possibly deal. They are no doubt familiar enough to many reputable firms that have been called in to put things in order. The use of cheap grade wire of small size that will get warm and destroy the insulation is one of the tricks. Another is to omit the proper conduit accessories, such as boxes, and simply to tape up the breaks in the conduit. Ordinary vulcanised rubber cables are sometimes buried in the plaster to save the cost of conduit. Flexible cords are even laid under carpets. For these and for many other reasons those engaged on electrical publicity work should not confine themselves to propaganda that merely aims at increasing the use of electricity. They should also endeavour to teach the public that all wiring work should be carried out in accordance with the Wiring Regulations of the Institution of Electrical Engineers. Possibly many suppose that a successful test by the supply authority prior to connecting up an installation to the mains is a guarantee that the contractor has done his job well. Unfortunately, this is not necessarily the case. These tests are primarily made to ensure that the insulation of the wiring system does not fall below a specified limit, and that the arrangement of the installation is such that disturbance or inconvenience will not be caused to other consumers in the district. Troubles owing to poor workmanship and material may not occur at the outset. They may take time to develop, and when they do develop the consequences may be serious.

People who endanger the lives of others, such as reckless motorists, are liable to be severely punished, but the careless electrical contractor escapes. Many have succumbed to quite low-pressure alternating current shocks, and to assume that the pressures that prevail in factories and private houses are harmless is absurd. Under certain conditions, they may prove very far from harmless, as reference to the annual reports of Mr. Scott Ram will show. At a time when so much money is being spent on teaching trades, and when so many capable people are available, it is little short of a calamity that electrical work should be carried out by people who do not understand the business. There are plenty of other fields for the unskilled, in which imperfect work is not likely to prove dangerous or harmful. In the absence of legislation or other drastic measures, the thing to be aimed at is to impress upon prospective users of electricity the importance of placing electrical installation work in the hands of really competent people. Once that idea has been instilled into the public mind, those who have been responsible for so much trouble and annoyance will find the electrical business less profitable, and will, it is hoped, be compelled to engage in work for which they are better suited.

BOOKS RECEIVED.

Rationalisation for Tin. By A. P. L. Gordon. London: The Saint Catherine Press, Stamford-street, S.E. 1. Price 2s. net.

The Restless Earth. By Professor H. L. Hawkins. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C. 4. Price 6d. net.

Annuaire des Carrières et des Industries Annexes, 1928–1929. Paris: "Mines, Carrières, Grandes Entreprises," 109, Boulevard Lefebvre. Price 41·25f. net.

Disrupted Strata. By M. H. Haddock, F.G.S., A.M.I. Mech. E. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 16s. net.

Fuel Research Technical Paper No. 23: *The Fusion Point of Coal Ash* (*Part I.*). London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

The Weekly Weather Report for the Period February 26th to March 2nd, 1929. Vol. XLV., New Series. Particulars of Temperature, Rainfall and Bright Sunshine for each week. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 15s. net.

Iron and Steel Institute.

No. II.*

THE next paper to be presented and discussed on Tuesday, September 11th, was one on "Crystallisation and Segregation Phenomena in 1·10 Per Cent. Carbon Steel Ingots of Smaller Sizes," by Axel Hultgren (Sweden).

CRYSTALLISATION AND SEGREGATION PHENOMENA IN CARBON STEEL INGOTS.

In the present paper are given the results of an investigation commenced in 1926 at the Söderfors Steel Works in Sweden. The paper deals mainly with 1·10 per cent. carbon steel with the following average contents:—Silicon, 0·20; manganese, 0·30; phosphorus, 0·012; and sulphur, 0·009 per cent. The steel was made in a 3·5-ton Elektrometall basic electric arc furnace. Ferro-silicon was added in the furnace, and aluminium usually in the ladle, though sometimes in the mould. The ingots were top-poured—big end up—through a nozzle generally 25 mm. to 28 mm. in diameter, though occasionally 23 mm. to 35 mm. in diameter. The ingot sizes investigated were 12in., 10in., 9in., 8in., 7in., 6in., and 4in. square at the top with rounded corners. The moulds were generally cold or slightly warm. A preheated refractory-lined sink head was used.

Some of the results obtained in the present investigation of 1·10 per cent. carbon steel ingots of smaller sizes are summarised as follows:—

(1) Among the smaller surface crystals of random orientation forming the first solidified skin, some develop into elongated crystals, which, during growth, form systems of parallel, partly disconnected, slender cruciform stems. The average direction of the elongated crystals at their base is perpendicular to the freezing point isothermal on transition from surface crystals to elongated crystals. Each elongated crystal, if not deformed, retains throughout its growth the direction thus fixed. From the stems grow transverse branches, which branch further, always in directions parallel to the three tetragonal axes of the crystal, a dendritic structure being the result.

The slender construction of the elongated crystals allows intergrowth to a considerable extent between the stems of neighbouring crystals growing in differing directions.

The growing surface layer of an ingot is subjected to deforming stresses, caused by suppressed contraction of the steel and by expansion of the mould. Two results of this may be mentioned, namely, inverse segregation at the surface, and deformation of the growing crystals, in parts and in bulk.

(2) In certain steels which solidify as δ-iron and then transform into austenite, a secondary structure—transformation structure—is formed, which often consists of elongated grains. The boundaries of such grains usually curve if the transformation isothermal changes direction, but they are to some extent modified by the heterogeneity pattern of the primary structure.

(3) The interior of the ingot usually crystallises from independent nuclei, free crystals being formed. Under ordinary, that is, quiet conditions a certain amount of undercooling is necessary for nuclei to appear. In consequence, the first few nuclei formed grow comparatively rapidly into large skeletons, a large-grained dendritic structure being obtained. If, however, the metal is stirred at a suitable temperature, which may coincide with or be somewhat higher than the temperature of spontaneous crystallisation and with sufficient force, numerous nuclei appear, and a small-grained structure is formed. In such crystals the branches are rounded and short, owing to their slower growth and mutual interference, and the dendritic habit is thus more or less obscured.

(4) The causes of segregation have been discussed in a general way, and the importance of relative movement between liquid and solid during the process of solidification has been pointed out.

(5) Segregation in the interior of an ingot is mainly of three kinds: $\wedge$-structure in an intermediate zone, $\vee$-segregation in the axial region, and segregation by sedimentation in the axial region (positive and negative).

It has been suggested that the first two forms of segregation are caused by movement of liquid through and deformation of the pasty zone—that is, the zone between the solid wall and the zone of suspended crystals—resulting from shrinkage in the outer parts of the zone. The absence of $\wedge$-structure in large-grained and its presence in small-grained ingots has been tentatively explained as a result of differences in thickness and structure of the pasty zone in the two cases, consequent upon the commencement of crystallisation with and without appreciable undercooling respectively.

The difference in regard to undercooling is also believed to account for the fact that negative segregation in the axial region was pronounced in 12in. ingots of small-grained structure, but was slight when the structure was large-grained.

(6) The effect of varying the taper of the ingot on the $\vee$-segregates has been demonstrated for different sizes of ingots.

(7) An ingot profile has been designed with large taper in the middle portion, where $\vee$-segregates are most liable to form, and little or no taper in the end portions.

Dr. W. H. Hatfield, who characterised the paper as a magnificent personal contribution to the subject, said—speaking as an individual, and not for the Institute's Committee on the Heterogeneity of Steel Ingots, of which he is Chairman—there was nothing in the paper which was really contrary to the findings or the manner of thought of the members of the Committee. The explanation of dendritic structure given by the author he regarded as the best he had ever come across; it was simple and easy to understand. With regard to under-cooling, he said he would like to know to what extent it was a serious matter as regarded liquid steel, and he doubted that it was a phenomenon of sufficient order to be taken seriously into consideration. With regard to after-pouring, which the author had used as a means of investigation, he said it was all right to use it in the manner in which the author had used it, but it was a very reprehensible practice when one was making steel, and he submitted that after-pouring—feeding steel through the head into the ingot proper in the manner described—led to the suction of the segregate right into the body of the ingot. It was a practice used in some parts of the world, and it was one which should be discarded. The feeder head should be intact as a feeder head; it should be filled at the same time as the ingot, and if that were done it would be found that the major portion of the segregate would remain in the feeder head. Of course, the author had dealt largely with very small ingots, and ingots of high carbon content; he had stated specifically that any deductions and observations which he might make related to the particular condition that he was study-

* No. I. appeared Sept. 13th.

ing, and that must be borne in mind in considering his results.

The author, and many people who were following that subject, had not given quite as much weight to the evidence put forward by the Ingots Committee as he thought they should have done. It had sometimes been said that the Committee had confined its publications largely to a statement of what was to be observed in current practice, and had not contributed substantially up to the moment towards a complete solution of the troubles of ingot manufacture. That, however, was totally wrong. The Ingot Committee, as a result of its investigations, had cleared away many difficulties, and had given a straight indication as to how a perfect ingot could be made. The evidence for that was to be found in its second report. That report contained the results of an extremely careful examination of two alloy steel ingots, one cast at a higher temperature than the other. In the one cast at the higher temperature a fairly large portion in the centre of the thick upper part was made up of very large crystals, and there were columnar crystals on the outside. The second ingot, cast from the same steel but at a lower temperature, contained a very small portion composed of the big crystals, no columnar crystals, and the rest of the ingot was composed of very fine crystals. It had actually been established that if one adopted an optimum, but lower, temperature, with the correct speed of teeming, one could produce the whole ingot as one mass of small crystals, which were almost simultaneously produced owing to the fact that the temperature gradient was very small. There had been produced at Sheffield a perfect ingot, in which there was no heterogeneity, no segregation, and no cavities, but it had been done only in ingots up to 1 ton in weight. In Sheffield they were concerned, not with the little toys such as were dealt with by the author—6in., 9in., and 12in. ingots—but with really large masses of steel, and, as would be seen from the work of the Committee, temperature was a very determining factor as regards the nature of the inside of an ingot; when one was producing an ingot weighing 25 or 50 tons, or even only 10 tons, one must bear in mind the changes of temperature during the casting of the ingot. It was very difficult to do on a large scale what could be done easily on a small scale. He hoped his remarks would make it a little more easy for those interested in the work of the Ingot Committee to read into the Committee's work and draw deductions from it, which up to the present people appeared not to have done.

Professor J. H. Andrew agreed that it was difficult to deal with segregation in large ingots when one had been considering ingots so small as those dealt with by the author. Discussing the author's reference to pasty zones in ingots, he said that the question of the pasty zone was rather peculiar. All steel makers seemed to think that at some stage or other the steel assumed a pasty condition, but he was rather doubtful whether there was ever a state which could be called pasty in steel. When one determined the freezing temperature of a steel one found that the greater mass of the steel became solid at a constant temperature, even though there was a fairly wide difference between the liquidus and solidus. What happened, he believed, was that the greater mass of the steel became solid, and a very small amount of liquid was present; but he did not think that part could be regarded as being of the nature of a pasty zone. Discussing after-pouring, he suggested that it would be interesting to after-pour with metal of entirely different composition, *i.e.*, to cast the ingot and then to pour on the top some steel containing a very high percentage of an alloying element, and then to follow the course of the alloying element in order to see what happened to the after-poured metal.

Mr. J. H. Whiteley, after a tribute to the author, said that if the study of the effect of after-pouring were continued it might yield valuable evidence as to the rate at which columnar crystals formed within an ingot, and it might also be of further value in checking any results which might be obtained by a mathematical treatment of the subject. The study of segregation was one in which it was necessary first to learn to float before trying to swim; it appeared that the author had gone in at the deep end, and it was necessary to fish him out. In the first place, he had stated that the fact that crystals slanted upwards in the ingot was the result of their crystallising at a normal to the isothermals. When the Ingot Committee—of which he is a member—was preparing its first report, he (Mr. Whiteley) had advanced that suggestion, but it was rejected entirely by the Committee, for a very good reason. It was that the ingots had been bled shortly after they were teemed, and in all the cases studied the wall of the ingot was found to be virtually parallel with the mould wall, *i.e.*, the isothermals were parallel with the mould wall, and would not account for the fact that the crystals were slanting upwards. The author's work rather suggested that the steel from the ladle penetrated almost to the bottom of the ingot. If so, the question arose as to whether the ingot began to freeze at the bottom first. He believed that in some cases it might begin to freeze at the top first, if the author's observation about after-pouring were correct. With regard to the segregation of carbon, sulphur and phosphorus, he said that carbon and phosphorus were definitely in solution in the steel; sulphur, as far as we knew—at any rate, sulphide of manganese—was out of solution. Further, carbon diffused comparatively rapidly in the solid, phosphorus diffused more slowly, and sulphur did not diffuse at all. Yet all the elements segregated to practically the same extent. Again, among the ingots studied by the Committee there were some examples of ingots cast in ordinary moulds, tapered upwards, *i.e.*, with the small end at the top, and the remarkable thing was that the segregate was not found in the hottest part of the ingot, where one might expect it. The hottest part of that type of ingot must be somewhere near the centre; the top and bottom were cooling, and yet the segregate was found near the top. The same thing had occurred in the ingot prepared by Sir Charles Parsons, where the segregate was at the top, though the last part to freeze was clearly some distance below it. That suggested that segregation really began in the liquid state; that for some reason unknown, carbon, phosphorus and sulphur associated in the liquid state just before freezing as a separate phase. With regard to the theory that the V segregate were due to a downward pull by a vacuum causing the lower part of the ingot to shrink, he said that it entirely overlooked the fact that gas was given off by steel when freezing, in varying amounts; even in the solid it might be given off. But whether the ingot was gassing or was quiet, the V segregates were still present; indeed, he was not certain that they were not more pronounced in the gassing ingots than in the quiet ones. If gas were given off, there could not very well be a vacuum, nor could he see how any vacuum produced at the bottom could pull solid crystals down.

Mr. Hultgren, replying to the discussion, could not agree with Dr. Hatfield that the results given in the paper were in no way contrary to the statements in the reports of the Ingot Committee. In the fourth section of the first report there was given an explanation of the V segregates, with which he could not agree. He did not think that the V segregates represented portions that had been drawn down from the top of the ingot; he believed they were born practically where they appeared—in the middle portion. Dr. Hatfield had doubted the importance of undercooling during the freezing of an ingot. If, however, there were no under-cooling, he (the author) could not explain the difference in structure of the large-grained and small-grained ingots, the latter produced by stirring. Obviously, large grain structure meant that there were few crystals, and in a small grain structure there were numerous crystals, and the cause of the production of the numerous crystals must be the after-pouring. The reason why, on undistrubed solidification, only a few crystals formed, must be under-cooling. With regard to Dr. Hatfield's suggestion that after-pouring would bring down segregates from the head of the ingot to the interior, he said it remained to be shown that material accumulations of segregate had formed at the moment of after-pouring. He would like Dr. Hatfield's opinion as to whether or not the production of a small-grained structure was due to the stirring effect of the stream at the finish of pouring.

Commenting on Professor Andrew's reference to the pasty zone, he said the pasty zone was that in which the mixture of solid and liquid had certain properties which might be expressed by the term "pasty." He would like a better expression, however, because he agreed that the liquid was not really pasty. He thanked Professor Andrew for the suggestion to after-pour with metal of a composition different from that of the ingot itself, and believed valuable information would be obtained in that way.

Dr. Hatfield remarked that Sir Robert Hadfield had done that, and had published his results through the Institute.

Dr. Hultgren, replying to Mr. Whiteley, said he did not believe that segregation in the liquid state had played any notable part in the ingots he had investigated. He suggested tentatively that it was not proven that sulphur was out of solution during the process of solidification of steel ingots of the composition with which he was dealing; he had always found sulphide inclusions distributed just as the segregates were distributed in those ingots, and he had concluded that the sulphur, or the substance forming the inclusions, where sulphur was present, must take part in the segregation, and consequently must be present in liquid solution. That, of course, did not apply to other compositions of steel. With regard to his explanation of the V segregates, he said he had not overlooked the presence of gas. Any gas present would be liberated to some extent during freezing, and in his view a partial vacuum would be formed, and he saw no reason why the V segregates should not be formed even in the presence of gas so long as the gas was not present in sufficient quantities to form bubbles.

He indicated that he would reply further to the discussion in writing.

The next paper to be taken was one by Mr. J. A. Jones on "High Elastic Limit Structural Steels," of which an abstract follows:—

HIGH ELASTIC LIMIT STRUCTURAL STEELS.

The chief object of this investigation was to explore the properties of the types of inexpensive steels likely to give the highest possible limit of proportionality accompanied by good ductility. The effects of additions of manganese, nickel, and silicon were studied and the most suitable content of special elements determined.

A minimum carbon content of about 0·3 per cent. is required to obtain the highest limit of proportionality. With this carbon content a high limit of proportionality with reasonably good ductility can be obtained by suitable additions of any of the special elements under consideration. Such additions involve an increase in the cost of the steel. Apart from additions of nickel, the actual cost of additions is not great, but the manufacture of high-quality steel containing special elements involves greater care in the selection of material and in the processes of production, while usually the difficulties of manufacture are increased. These difficulties have been successfully overcome in the case of steels containing manganese and nickel, but difficulties seem to be experienced, particularly in Germany, in the manufacture of steel plates of high silicon content. These have been described in detail by Wallmann. Higher temperatures of melting are necessary and result in more rapid wear of the furnaces and moulds. The steel pipes deeply, which involves a high percentage of discard. Higher annealing temperatures or higher finishing temperatures in rolling have to be employed for the plates, and greater care must be exercised in reheating in order to avoid cracks. It is, however, admitted that if the reheating of the ingots has been carefully conducted the rolling of plates of normal dimensions does not present any special difficulty.

Schulz also refers to the difficulties arising in the large-scale production of silicon steel, and describes a new structural steel, developed by the Dortmund Union Works, of the following approximate composition:—Carbon, 0·15 to 0·18; silicon, 0·25; manganese, 0·8; copper, 0·5 to 0·8; and chromium, 0·4 per cent. It is stated to have mechanical properties as good as those of a silicon steel of similar carbon content, and it is claimed that the steel offers distinct advantages in its behaviour during manufacture and working. The amount of scrap produced is small, and in spite of the additional cost of the special elements the steel can be produced more economically and with more reliability than silicon structural steel. It is much easier to weld and is more resistant to corrosion. Like other German steels, it has a lower tensile strength than the steels with the highest limits of proportionality considered in this paper, but if the claims for the steel are substantiated an increase of the carbon content with an adjustment of the copper and chromium contents might lead to the development of a steel of high quality possessing a high limit of proportionality and good ductility.

The author has come to the following conclusions:—The effect of carbon, manganese, silicon, and nickel on the properties of structural steels, in the form of plate and of flat bar, has been investigated, and the general conclusion is drawn that the type giving the best tensile properties is that containing 0·3 per cent. of carbon with about 1·3 per cent. of manganese and 0·9 per cent. of silicon. Next in order would be a similar steel with higher manganese and lower silicon, tending towards a limit in the manganese content of 1·6 per cent. when the silicon is less than 0·3 per cent. A small amount of nickel increases the ductility of low-carbon steels, but at least 3 per cent. is required in producing high elastic limit steel. For the latter purpose the suggested use of a small amount of chromium at a lower cost than the equivalent larger amount of nickel appears to be more promising.

Mr. W. Simons, after commenting on the increasing interest of the high elastic limit steels, said that the Admiralty was recognising the importance of elastic limit, and if it were necessary in Admiralty steels it was necessary even in mild steels. The elastic limit, or limit of proportionality, was the true test of the value of the steel, and he was surprised at the great variation in the elastic limit of ordinary mild steels. The engineer used a very large quantity of ordinary mild steel, and the limit of proportionality was important to him. The variations he himself had found, ranging from 8 to 11 tons in ordinary mild steel, were too great, and attention must be paid to the production of steel with a narrower limit of proportionality. He believed that in the future engineers would pay greater attention to the limit of proportionality than they did to-day to the ordinary tensile breaking strength of ordinary steel.

Dr. Hatfield, commenting on Mr. Simons' remarks, said that undoubtedly the limit of proportionality was a factor which had been used largely by the consumer in dealing with this class of steel, but the limit of proportionality was a very unsatisfactory value, and he considered that it could well be replaced by a proof load, in which there was a minimum extension of the piece at a given load. A lot of trouble had arisen because attempts had been made sometimes to fix that load at the point where the straight line was departed from. A refined yield test was needed. It was interesting that Mr. Jones, who might be regarded as external to the industry, had given the results of an impartial quantitative examination of a number of steels within a range of composition of great importance; it was a range of composition in which greatly improved properties had been obtained without heat treatment being necessary. Those in the special steel industry used higher proportions of the elements, and hardened and tempered. In the production of steel in plates and sections, and so on, what was really required was an improvement in mechanical properties with as little inconvenience in manufacture as possible, and undoubtedly several of the compositions Mr. Jones had dealt with would give the desired result.

Mr. J. H. Whiteley asked what was the real practical value of the limit of proportionality test? He had put the question to several engineers who used it, and they had all said that a good limit of proportionality ensured good quality. He was inclined to agree with that statement, but pointed out that, in order to determine the limit of proportionality, at any rate in steel plates, the test piece must be carefully prepared, burned out with oxygen, there must be no shearing, and the plate must be straight; any straightening, if the plate had been bent, destroyed the limit of proportionality. In his view the cross bend test was a better test for quality than the limit of proportionality. If a high tensile plate could be made to stand the bend test prescribed by the Admiralty, it did not matter very much what the limit of proportionality was.

Mr. F. Bainbridge, speaking from the point of view of the section trade, said that whilst he agreed with the author that manganese did increase the limit of proportionality—and by "limit of proportionality" he really meant a refined yield point as determined by

such an instrument as the Ewing extensometer, in conditions under which one put on a certain load, removed the load, and then read the micrometer gauge, rather than by means of a curve—it appeared that the author had been rather unfortunate in the selection of his mild steels, and that his limits of proportionality were low for this class of material—at any rate as regards rolled sections. He suggested that for ordinary mild steels—angles and joists of ordinary Lloyd's quality—it was usual to obtain limits of proportionality of from 13 to 15 tons, instead of from 8 to 10 tons. Giving examples of some steels his firm had made, he said that an 0·20 per cent. carbon steel, with 0·61 per cent. manganese, gave 30 tons tensile, 26 per cent. elongation on 8in., and 15 tons limit of proportionality. An 0·18 per cent. carbon steel, to which was added 0·25 of copper—for its anti-corrosive properties—gave 27·8 tons tensile, 32 per cent. elongation, and, on various test pieces, from 14 to 16 tons limit of proportionality. The manganese content of that steel was only 0·57 per cent. All these steels were made as clean and free from oxide inclusions as possible in a large open-hearth plant, and he suggested that if the author had taken oxide and inclusions into consideration he would have found marked differences in the limits of proportionality and bends. It would be a great pity if a specification were drawn up which included a manganese content of over, say, 0·9 per cent. Manganese was a treacherous element, and when large continuous open-hearth furnaces were in use and manganese was added in the ladle there was always some danger of brittle spots occurring in the finished bar, owing to spots of ferro-manganese, unless extreme care were taken or the ferro-manganese was added molten. He did not think manufacturers of sections would be anxious to normalise bars after rolling, nor did he think it necessary if a fair amount of care were taken to ensure that the bar was not finished at too high a temperature.

Mr. V. B. Reichwald said that the problem of the use of manganese-silicon steel was engaging the attention of railwaymen. On the Continent, and also in America, they were aiming at the high-capacity goods truck, which was also engaging the attention of railway people in this country. Only on the previous day the London and North-Eastern Railway Company had placed their first order for thirty 40-ton self-discharging trucks. On the Continent there were in use some 80-ton self-discharging wagons with a tare weight of only 19 tons which was just under 25 per cent. In the United States and Canada the railways were departing from the wood-sided wagon to adopt the manganese steel wagon, and were getting the tares down to about 25 per cent. Thus, from the practical point of view, manganese-silicon steel with high tensile strength, a favourable elastic limit and a strong resistance to the abrasive action of hard minerals was very important indeed.

Mr. Jones, replying to the discussion, said that a test on the lines referred to by Mr. Bainbridge was more or less in the nature of a proof test, and the limit of proportionality, determined in that way, naturally depended on the accuracy of the instrument used. Referring to the remarks of Mr. Bainbridge with regard to normalising, he said he had intended to say in the paper that attention to accurate finishing temperatures during rolling would answer the same purpose as normalising. He agreed with Mr. Whiteley's remarks with regard to the limit of proportionality test, but believed there were certain cases in which a slight departure from good heat-treating practice had been made evident by a very low elastic limit, but had not been revealed by a bend test. The bend test, however, did detect 95 per cent. of any of the defects that might be present. With regard to Mr. Bainbridge's criticism of the values referred to in the paper, he referred to a paper read by Sir William Berry at the centenary meeting of the Institution of Civil Engineers, in which had been mentioned some values for mild steel plate which were much lower than those given in this paper. He admitted that if particular care were exercised in the manufacture of mild steels and if the temperatures of finishing were carefully controlled, very much better results than those referred to in his paper could be obtained, but the plates he had mentioned had been taken at random from consignments delivered, and were not specially selected. He had not experienced the evil effects of the segregation of manganese in any of the samples of plates examined, and evidently there was practically no segregation, judging from the variation in hardness obtained. It appeared that the segregation trouble had been rather over-emphasised by Mr. Bainbridge.

On Wednesday morning Mr. J. H. Whiteley presented a paper on "The Coalescence of Pearlite," of which he gives the following summary :—

THE COALESCENCE OF PEARLITE.

The transformation of γ-iron solid solution to pearlite in hypo-eutectoid steels occurs over a small range of temperature immediately below the A_r point. It is shown that coalescence resulting in the formation of cementite borders to pearlite takes place within this temperature range, and before all the γ-iron is transformed ; it is due to the fact that carbide is transferred by diffusion from the γ-iron to the adjacent pearlite areas. It follows that the longer the time during which the steel is cooling through the Ar_1 range, the greater will the coalescence tend to be. The most marked effects were produced in steels very low in manganese. With samples containing more than 1·0 per cent. coalescence was not obtained.

Professor J. H. Andrew, the only speaker on the paper, suggested that Mr. Whiteley had introduced a problem without solving it. He was surprised that Mr. Whiteley, as a member of the Ingots Committee, had not considered the possibility that the carbide might have been segregated in the gamma iron, and have come out of solution owing to that segregation. He suggested to Mr. Whiteley two experiments. The first was to soak the steel at the highest temperature he could—about 1350 deg.—in vacuo, taking care not to cross the gamma-delta border, and then to cool to his usual soaking temperatures—685 deg. and so on—directly, and to study the effect. Professor Andrew's contention was that if the carbon were homogeneously distributed there was not coalescence of the cementite. The second experiment was, using a steel containing about 1 per cent. carbon, to cool to a temperature just between the S E line and the Ar_1 change, and soak at that temperature. By soaking at that temperature he should be able to reduce the large amount of free cementite and free ferrite. He was pleased Mr. Whiteley had found that manganese prevented the segregation of cementite. In a paper by Dr. Dickie it was suggested that manganese increased the solubility of carbon in alpha iron, but he himself believed Mr. Whiteley was correct in assuming that manganese decreased the solubility of carbide in alpha iron.

Mr. Whiteley intimated that he would reply in writing.

The following papers were taken as read :—

H. A. Dickie, "The Solubility of Carbide in Ferrite"; T. D. Yensen, "Iron-silicon-carbon Alloys, Constitutional Diagrams and Magnetic Properties"; T. A. Rickard, "Iron in Antiquity."

There was no oral discussion, but written contributions were invited.

On Thursday morning, September 12th, the first paper to be taken was one by Mr. E. G. Herbert, entitled "The Hardening of Superhardened Steel by Magnetism : The Lattice Resonance Hypothesis."

Some idea of the contents of this paper may be derived from the following extracts :—

HARDENING BY MAGNETISM.

It had been found that when metals so diverse as brass, low-carbon steel, stainless steel, invar—all soft—and high-carbon steel and high-speed steel in the hard state, had been work-hardened by the cloudburst bombardment with hard steel balls, all possessed a propensity to become still harder. It was known that this propensity was to some extent satisfied by a process of ageing, and that the hardening propensity was assisted to fulfilment by heating the metals for a short period to a particular temperature, which, under the designation of the "P_2 temperature," had long been associated with a maximum work-hardening capacity of the metals, as revealed by the pendulum scale work-hardening test. The diversity of the metals to which these facts applied, and the lowness of the temperatures involved, seemed to put out of court any metallurgical explanation such as recrystallisation or change of chemical constitution and pointed rather to some atomic rearrangement in the crystal structure. In attempting to form a mental picture of what might be supposed to occur, one conceived that the cloudburst bombardment caused slip to take place along a great diversity of crystallographic planes, with a disarrangement of what Rosenhain has called the "irregular" metal between the displaced crystalline layers. One conceived; further, that the disturbed space lattices in these area were in a state of such instability that they tended, under the stimulus of a particular temperature, or even to a slight extent without such stimulus, by a mere process of ageing, to undergo such a reconstruction or rearrangement, or perhaps interlocking of the contiguous layers, as would result in an increased resistance to deformation, manifested by increased hardness.

The question arose whether it might not be possible to apply some stimulus other than the low-temperature or P_2 anneal to assist the propensity towards rearrangement of the lattice which appeared to exist in the work-hardened metal. The most likely stimulus in the case of a magnetic material appeared to be a repeated change of magnetic polarity, which might be expected to disturb or distort the lattice, and thus assist it to fulfil the existing propensity towards a less unstable arrangement. With this end in view the following procedure was adopted :—

A specimen of steel which had been work-hardened by the cloudburst process was placed with the treated face downwards across the poles of a powerful electro-magnet, and several taps were administered to the back of the specimen with a light hammer. The specimen was then turned through 90 deg. in relation to the magnet, and the light taps were repeated. This process was repeated until the specimen had been revolved fifty times in a clockwise direction by stages of 90 deg. with light hammering at each change of position. The direction of rotation was then reversed, and fifty more revolutions were given—that is, 400 changes of position with consequent changes in the direction of polarity.

The specimen was then tested for hardness with the pendulum. Its hardness was found to have been increased by the magnetic treatment to almost exactly the degree of hardness which it had been found possible to induce by the P_2 anneal in another portion of the same specimen.

The P_2 anneal and magnetic treatment appear to be strictly alternative processes producing the same atomic rearrangement. Thus, it was found that when the specimen which had been magnetically hardened was afterwards subjected to the P_2 anneal, no further increase of hardness resulted. Likewise the specimen annealed at P_2 showed no further increase of hardness when subsequently subjected to magnetic treatment.

The magnetic treatment has been applied to a diversity of steels work-hardened or superhardened by cloudburst, and in every case the increase of hardness has resulted as anticipated. The P_2 anneal and the magnetic treatment are equally effective, whether applied to soft steels work-hardened or to hard steels superhardened, but in the latter cases the temperature anneal was carried out at 120 deg. Cent.

The magnetic treatment was arrived at by inductive reasoning from the observed facts of the increased hardening of previously work-hardened metals as a result of ageing or of the P_2 anneal, the hypothesis being that both these processes led to a readjustment of the space lattice. Successful prediction is generally regarded as confirmation of the soundness of the hypothesis on which it is based.

Assuming, then, that the observed increase of hardness is due to a change in the space lattice from a condition of instability to one of stability as a result of ageing or under the artificial stimulus of an agitation of the lattice by changes of magnetic polarity or by heating to a particular temperature, it remains to inquire why a particular temperature should be effective in causing agitation of the lattice, and to find if possible a correlation between the hardening effect of the P_2 anneal and the six critical change points in the temperature/work-hardening curve.

Consideration of the facts has led the author to adopt tentatively the "lattice resonance hypothesis" which may be stated as follows :—A given space-lattice, such as that of iron, possesses a natural vibrational periodicity, analagous to that of a piano string tuned to a given musical note. Just as the piano string, under the influence of a sound of rising pitch, such as that of a siren, will exhibit alternate periods of vibration and quiescence—vibrating when the rising sound reaches the fundamental periodicity to which the string is tuned, ceasing to vibrate when the rising sound is in discord with the fundamental pitch of the string, and vibrating again when the rising sound passes through the successive harmonic periodicities, the third, fifth, octave, and tenth musical intervals, with intervening periods of discord and absence of resonance—so the space-lattice will respond to the increasing periodicities of a rising temperature, passing through alternate conditions of maximum and minimum vibration as the two periodicities, that of the heat vibration and that of the lattice, pass through conditions of alternate harmony and dissonance.

On this hypothesis, the P_2 temperature should be one of maximum lattice vibration, conducive to that rearrangement of the distorted structure which has already begun when the structure is aged, which can be assisted by the alternative process of magnetic treatment, and which manifests itself by an increase of hardness.

The lattice resonance hypothesis must at present be regarded as a tentative endeavour to connect the apparently interrelated phenomena of low-temperature changes in work-hardening capacity and in limit of proportionality, age-hardening, low-temperature annealing, and magnetic hardening of metals. In its present form it does not suffice to account for these phenomena, but it may serve to raise them from the realm of sectional metallurgy to that of atomic physics, where they undoubtedly belong, and to point the way to a more complete and more correct explanation.

Dr. W. H. Hatfield said it must be conceded by all that Mr. Herbert's experimental work was of the highest order, and the paper contained much new data which enriched our knowledge, but the hypothesis he had put forward would require a good deal of consideration. In the first place, the distortion and breaking up of the space lattice was stated to account for the hardening by cold work, and the subsequent increase of hardness was accounted for by what amounted to a reduction of potential energy so caused. One could not readily see that in one case an increase in potential energy caused an increase in hardness, whilst in the other a further increase in hardness was caused by a subsequent reduction in potential energy. The lattice resonance hypothesis, as stated, was not very strong, and few would accept it in its present form. The analogy presented with a piano wire and a vribating source was not a good one, since, whatever the vibrating source, the piano wire would respond only when that source had certain definite frequencies. A heating source had no definite frequency, and, as the author had pointed out, it might have a different range of frequencies according to the nature of the material comprising the heating source. If the author's theory were correct, therefore, the resonance temperatures should be different according to the method of heating employed ; different results should be obtained if the material were heated in a silicon muffle, in an iron muffle, or by radiation from gas flames. He believed it would be conceded that no such difference would ever be observed. There was a further weakness in the paper. It was stated that the P_2 temperature should be one of maximum lattice vibration, conducive to that rearrangement of the distorted structure which manifested itself by an increase of hardness. At a later stage, however, when discussing Dearden's work on specific heat, the author had stated that the three maxima of the temperature/work-hardening curve, including the important P_2 maximum, should correspond to conditions of dissonance and of minimum vibration.

Mr. A. Hultgren (Sweden) said he had experimented with cold work on hardened steel balls in order to increase the hardness for a specific purpose, and had also tried heating at low temperature after work hardening, but had not obtained the improvement in hardness which the author had obtained, and where the peak was attained at 120 deg. Cent. He did not doubt, however, that such an effect did exist.

Mr. Herbert, replying to the discussion, thanked Dr. Hatfield for his criticisms of the hypothesis put forward in the paper, because he had put it forward mainly to be fired at. Some of the objections referred to by Dr. Hatfield he himself had already pointed out, as, for instance, that the maximum vibration seemed to turn into a minimum, and one could scarcely expect the minimum to have a maximum effect. The point with regard to different rates of vibration resulting from different methods of applying heat, however, was entirely new to him, and he asked Dr. Hatfield to deal with it further in a written contribution he had promised. He (Mr. Herbert) would have thought that a given temperature corresponded to a certain rate of vibration or rates of vibration, and that the manner in which the heat was generated was a matter of indifference.

Perhaps the reason why Mr. Hultgren had not effected an improvement in hardness by the methods indicated was that he was not looking for it as carefully as was necessary. When metallurgists set out to do temperature work, they almost invariably selected intervals of temperatures such as 50 deg. or 100 deg., and assumed that nothing could happen in between those temperatures ; by so doing they missed a good deal. In searching for the mysterious changes referred to in the paper, he had found it necessary to adopt very much smaller intervals of temperature, intervals of 5 deg. or even 3 deg. in some cases, in order to make sure that he did not miss anything.

The last paper to be read was one on the "Electrical Conductivity of Magnesite and Some Other Refractory Materials in relation to the Temperature and their other Properties," presented by Messrs. Diepschlag and Wulfestieg. The authors reach the following conclusions:—

ELECTRICAL CONDUCTIVITY OF REFRACTORIES.

(1) On the whole, the experiments confirm the results hitherto obtained. The most remarkable property is the very great degree in which the electrical resistance depends upon the temperature. The curves are distantly analogous to an exponential curve. With rising temperatures, the resistance first falls rapidly, the fall becoming slower at high temperatures.

(2) A constant curve of resistance of magnesite reproducible at will does not exist, because it is apparently impossible to get a material completely homogeneous externally and internally. Therefore, a curve representing the mean value of some experimental results may be considered as the "resistance curve of the material."

(3) The curves of the previously burnt and of the unburnt materials show great differences. The reason is that during the burning process internal transformations take place which influence the electrical resistance until they are completed.

(4) Stable systems of materials show correspondingly regular curves. Anomalies indicate unstable conditions, but these can be removed by burning for a long time. For this reason, all unstable materials require a certain minimum burning time. For the magnesite used in the authors' experiments, the minimum burning time was found to be about twenty-six hours at a temperature of 1550 deg. to 1560 deg. Cent.

(5) If the burning temperature is too low, these materials show new curves at higher experimental temperature ranges, and even at low temperatures. The internal transformations of the material when completed at a certain temperature give a maximum curve of resistance.

(6) At every temperature, if it is maintained long enough, an internal stable condition is reached, which can be expressed by constant values of resistance. The period of heating differs for different ranges of temperature, and this is useful in helping to determine the duration of the reactions. The difference between the first curves and the final curve probably gives a correct idea of the intensity of the reactions.

(7) An increase of pressure in manufacturing the specimens reduces the values. No doubt there is a relation between pressure, size of pores in the specimen and resistance, but this cannot be definitely determined.

(8) The smaller the size of grain, the lower the resistance becomes.

(9) By changing the chemical composition, it is possible to change the values of resistance as well as the form of the curve.

(10) There is an important difference in the course of the curves of light and dark oxides. MgO, SiI_2, Al_2O_3, and CaO have nearly straight line curves at temperatures over 1500 deg. Cent. Fe_2O_3 and Mn_2O_3 have curves which drop suddenly at lower temperatures.

(11) The resistance curves may be arranged in the following order—SiO_2, Al_2O_3, MgO, CaO.

(12) The addition of white oxides, especially SiO_2 and Al_2O_3 tends to lower the electrical resistance of common magnesite.

The following papers were taken as read, and were not discussed orally, though written contributions were invited:—"The Hardness of Vacuum-Annealed Crystals of Iron," by H. O'Neill; "The Correlation of Fatigue and Overstress," by Messrs. Smith, Connor, and Armstrong.

Technical Education from a Students' Point of View.

No. III.*

THE general features of college education present a difficult problem; everybody knows that it is much easier to teach a small class than a large one. The professor who lectures in a hall containing more than one hundred people on a subject that presents any difficulty to his audience is in a quandary; he cannot tell how much his audience is absorbing. The "brains" are in the two front rows—they always are—and he can see well enough whether they understand him; but it is to the backward man that a lecture should be delivered, and the professor does not know for certain who is backward. Even if he did, it is probable that the man is at the back of the hall—he always is—presenting an absolutely blank countenance. Naturally enough the professor lectures to those whom he can see—that is, the "brains"—making certain that they follow him, and he hopes for the best as regards the others. The remedy, of course, is obvious: smaller classes. It is probable that few men can teach efficiently more than twenty students, and twenty is a maximum.

The professors are helped by demonstrators. At the end of the lecture the body of students is split up into classes and each student settles down to work examples; a demonstrator looks after each class. At the writer's college a special notebook was kept, in which examples for that one particular subject were worked out; at the end of each half-session the book was sent in for marking. This system is bad. The book should be sent in each week, so that the professor may see for himself how well each class is progressing. Professors would then be amazed to discover how little their audiences grasped and how much was taught by the demonstrators; this is not to say that the demonstrator is a better teacher than the professor; it only means that he is in closer personal contact with the students. The loss of this close personal contact is harmful to professor and student alike. The professor tends to get "above the heads" of his pupils in his lectures and the students get a bad impression of his lecturing and lose interest. And when the student loses interest he will not learn very much. Lectures on any subject, if they are to be of much use, must keep up the interest of their audiences; the ideal lecturer would always send away his audience wishing for more—even of a technical subject. For this purpose demonstrations are extraordinarily useful; even if, as education, they are of little value, they are very valuable for keeping a class awake and eager; but if they are to realise their true value the class must be small.

The colleges hamper their professors in another way, small though it is. It is a misguided idea that students can only be kept awake by providing them with very hard wooden seats. And here is another fallacy. Because a professor knows more about his subject than anyone else in Europe or America, that does not necessarily mean that he can teach. The man who knows so little that he cannot teach third-year students is far more likely to make his pupils understand him; he understands their difficulties and is more likely to get into personal contact with them.

Experience seems to show that the average teacher can teach the average pupil everything he knows providing that there is close personal contact between them; the teacher must know his pupil. When a class consists of a hundred men this is impossible and the result is inefficient teaching.

But what can the technical colleges do? The professor cannot give the same lecture five times a week to classes of twenty; he has not the time. But at least the colleges could alter what they teach. They teach what they do teach because there is a degree. The degree is a part of the great examination system; it is the keystone of that structure. The value of the examination system has been questioned over and over again. There were many successful men at college who had no chance of holding any responsible position thereafter, men without will power, men without the imagination to stray from a formula, men who dare not do anything without asking somebody's permission; most of them "brains." Whereas, as often as not, the man who will "get there" in life, the man of daring and enterprise, the man who starts up a machine whether he knows how to stop it or not, the man who gets things done, is often quite a failure when the examination paper is thrust before him. He cannot bother to remember formulæ. But set him a nice little problem of general type—no formula required—and he will devise a "working" answer; give him a problem in design, his answer will work.

The great examination system cuts out those who have not got the examination mind besides those who have not got the cleverness; it lets through many who are clever, but lack character. Everybody realises this, but everybody does not realise its effect on education.

It has been said that mathematics is the basis of a technical education. As far as mechanical engineering is concerned a more truthful remark would have been that arithmetic is the basis of that technical education. Nobody likes mathematics, except the true mathematician. The amount of mathematics taught should be strictly proportionate to the amount that is needed. The mechanical engineer need go no deeper into the subject than to the elements of the differential and integral calculus. What, then, is the use of teaching him imaginary numbers and differential equations? The electrical engineer may need them; the mechanical engineer does not. Differential equations were included in the third-year course in mathematics at the writer's college. After the first two classes and when the students began to realise how much work there was to be done on other subjects. the attendance at these classes was very much reduced. The student had not the time for it. Like the syllabus of many other subjects, that of mathematics might be reduced considerably without, however, reducing the amount of time devoted to it. Mathematics is taught by mathematicians; might not an engineer know better what was required? The basis of engineering is applied science; it is therefore necessary for the engineer to have a sound knowledge of light, heat, sound, and electricity. Physics is as a rule only taught during one year, and somewhat sketchily at that. Most of the matter may be good, though more advanced perhaps than necessary. But the time allowed is insufficient. Chemistry, on the other hand, is largely unnecessary to the engineer; he has very little to do with it unless he is specialising in metallurgy or a kindred subject. A knowledge of chemical equations, the properties of acids and alkalies and certain well-known substances; the molecular and atomic theories and their application to gases, is practically all that is necessary. This might very well be taught at school before the student came to college.

Yet the student is taught qualitative and quantitative analysis and many other things in the first year, and there is also a shorter second-year course; this is so sparsely attended and the students are so inattentive that the engineers' class is, as often as not, a standing joke with the chemistry professors.

There are four very important subjects—Heat Engines, Mechanisms, Strength of Materials, and Drawing and Design. Design, of course, is really the application of the other three, and it is used a little, therefore, as an exercise in the other subjects.

In all these subjects there is far too much and too advanced theory. If, in the Heat Engines classes, the professors concentrated on teaching the students how to use the steam tables, and forgot to give them complicated questions involving all sorts of other considerations, they would be more capable of building on their knowledge when they left college. If the student is well founded and absolutely certain about the laws of gases, he can deal with any theoretical problem in internal combustion engines; but few of the students who take the degree examination are as certain of these laws as could be wished. They have not been taught much more than this, but their minds have been puzzled by theoretical efficiencies and various cycles before the principles were firmly grasped. If the lecturers made certain first that the principles *were* firmly grasped, the teaching of cycles and efficiencies would be a matter of minutes instead of hours.

Recently the author heard an alternative method of teaching heat engines advocated. The lecturer—a competent engineer—was to ask his pupils to make a good sketch of, say, a boiler. It could be any type they liked, but the sketch must show the general arrangement and the method of fixing or holding all important parts. The lecturer would collect the sketches at the next class, and he would proceed to criticise them. This one, for instance, gives a design for a water-tube boiler, the tubes thirty or forty diameters long; these tubes are shown firmly held at each end. The lecturer can then demonstrate theoretically, and, if possible, by means of a model, exactly what will happen if the fires are lighted, and he can suggest a better method of holding the tubes. This design shows very little steam space, no steam dome, and no superheater. The lecturer can demonstrate by means of steam tables that the wet steam produced will contain less energy than dry steam, and can enter into various discussions about steam.

The scheme is attractive, but it is doubtful whether the students would be able to pass the degree examination after such a course. But they would have had a better engineering training. They would at least have gained an engineering "sense," the ability to criticise or appraise a design, and the ability to make a sketch. The scheme calls for a lecturer of excellent capacity, and a library and a librarian well stocked with knowledge. The pupil should be encouraged to use the library for help in his classes; a "library class" might be useful—a knowledge of where to find knowledge in books is as valuable as knowledge carried in the head.

Mechanisms is taught almost entirely from the theoretical point of view. So much is this so that the student has a tendency to forget that there is such a thing as a valve and thinks of it in terms of the valve diagram. The opportunity to show to the student what a certain motion can do is lost in exploring by theory why it does it. There is a book entitled "Mechanical Movements, Devices, and Appliances," or something of that sort; it is quite a large book, and it gives drawings of various movements from plain gearing to complicated link motions, from the ordinary wedge to complicated levers. There is hardly a mathematical formula in it, but each motion is carefully explained, and far more easily understood than it would have been if the theory of each had been given in mathematical terms.

Mechanics, which is the basis for so much in engineering, is taught by mathematicians! but it is well taught, for much of the work is done by experiment.

Strength of Materials is a simple subject in its elementary theory. It consists essentially of the formula—

$$\text{Load} \div \text{area} = \text{stress}.$$

The difficulty is to find how the load acts on the material. Here, again, the tendency at college is to try to find out how the load acts mathematically. It would be better to discuss in general terms how it would be expected to act, and then to use mathematics to find its magnitude. After all, mathematics has discovered very little by itself; it has only extended knowledge originally gained from experiment. Could mathematics discern the properties of steam? No; but if some of the properties are discovered experimentally, it can suggest that this material has others. Was electricity discovered by mathematics? No; but once discovered, the rapidity of its development was accelerated by mathematics. The engineer is undoubtedly on the side of those who discover by experiment, by trial and error. The mathematician is at hand to develop his discoveries. In such a manner the engineer should be taught.

(To be continued.)

* No. II. appeared Sept. 13th.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PERPETUAL MOTION OF THE SECOND ORDER.

SIR,—I have read your leader in THE ENGINEER of August 23rd on "Perpetual Motion of the Second Order," and think it a very good idea that you have mooted a subject which has basked of late years in comparative neglect.

But whilst I allow full deference to the views therein elaborated, I think it rather unfortunate that you should have chosen a condensing turbine or engine as a type commonly expected by these "saps" of inventors to yield the "perpetual motion" as above. It is surely obvious to any engineer of understanding that such a machine must depend for its working in the abstraction

of heat and equally obviously no known process exists by means of which such heat can be rendered serviceable in heating the water in the boiler.

Please remember that such perpetual motion that you speak of, or rather imply, does not demand a thermal efficiency of 100 per cent. If you could get 95 per cent., or, say, 90 per cent., part of this work might be used in refrigeration (negative work), so wiping out the odd 5 or 10 per cent., and leaving you with say, at a venture, 60 per cent. effective work. Such a state of affairs would enable you to reverse the second law effectually enough and tap sub-atmospheric heat to useful work. It is because our present-day heat engines fall short of even 50 per cent. that we cannot recover a minute proportion of this heat as work. In practice, of course, more than 50 per cent. would be necessary, probably 80 per cent., with the efficiency of modern methods of liquid air refrigeration considered. But at present it is taxing us to run our power plants at a steady average of 30 per cent. overall efficiency, so we can afford to ignore these possibilities, though the fact that an exact 100 per cent. conversion is not strictly necessary seems to me a new way of looking at the question.

H. J. NORTHFIELD.

Ipswich, September 13th.

HARDNESS TESTS.

SIR,—In the article "The Hardness and Abrasion Testing of Metals,"* by G. A. Hankins, D.Sc., which appeared in your issue of July 19th, page 61, the author mentions the Haigh prism hardness testing method. As I have considered myself, up to now, to be the originator of this method of tool steel hardness testing, and successfully applied it in 1923 in the course of my investigations into the most suitable hardening and drawing temperature for high-speed tool steel, carried out in the laboratories of the Skoda Works, Ltd., I should like to submit to the kind attention of your readers some additional information about the method in question. The full description of my experiments has been lithographed in Russian and Czech languages, and the method itself has been mentioned in some special papers read in Prague and Pilsen.

I have never attached a universal value to this method, but for the purposes of my particular investigation I considered it to be more suitable and more sensible than the Brinell's method applied for the similar investigations by E. Schneider in France or that of Shore used by J. A. Matthews in America.

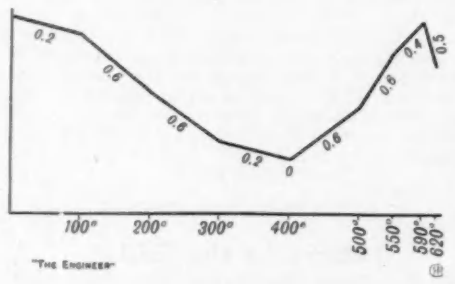
It was absolutely impossible for me, in view of the high cost and long time required, to carry out the investigations of high-speed tool steel in workshop service, similar to those made by Taylor and by his followers, such as d'Arcambal, Bureau of Standards, Strauss, French, and others. Besides, all the methods of investigating tool steel in service often show such marked variations for the individual test results that average figures obtained as a result of these experiments cannot be considered, from the standpoint of the theory of probability, as being of value.

In my experiments the prisms tested had a testing angle of 60 deg. and only in the case of a very brittle material this figure amounted to 90 deg. Hardness was defined on the basis of the indentation depth, and not of its width. Accuracy of measuring was 0·1 mm. The respective hardness values of the prisms hardened in a similar manner and drawn to the temperatures of 100, 200, 300, 400, 500, 550, 590, and 620 degrees Cent. were compared for each kind of steel.

No standard prisms were used in stating the hardness values, but the hardness figure obtained for each prism was compared with that of the prisms tempered to the next drawing temperatures.

The differences between the values of depth of the indentations of the two prisms held crosswise under a load of about 2500 kilos. served as a criterion of the differences in their hardness.

A curve was plotted for each kind of steel, its abscissæ representing the respective drawing temperatures, and



HARDNESS TEST—TUNGSTEN STEEL

the ordinates the differences in depth of the indentations of the two crossed prisms. The chart given above shows such a curve for tungsten steel containing 18·1 per cent. tungsten and hardened from the temperature of 1320 deg. to 1350 deg. Cent. It will be seen from the chart that the minimum hardness is found at 400 deg. Cent. In crossing the prisms drawn to 400 deg. to 300 deg. Cent. respectively, the difference in depth of the indentations was 0·2 mm.

In the interval between 100 deg. and 300 deg. Cent., a continuous steep decrease of hardness can be observed. Drawing the temper to 100 deg. Cent. caused a small decrease of hardness—0·2 mm.—while for some kinds of steel no decrease of steel hardness up to 100 deg. Cent. could be detected; in some cases even a slight increase of hardness could be observed when heating to 100 deg. Cent. The right branch of the curve rises steeply to a maximum corresponding to the hardness of steel subjected to no drawing treatment. Having reached its maximum, the hardness suddenly decreases when the steel is heated further.

The most essential conclusion as drawn from my experiments I consider to be the fact, a definite indication of which I have never met with in literature, namely, when heated to any temperature up to 590 deg. Cent., high-speed tool steel retains the acquired hardness in all the following heatings, provided the respective temperatures do not exceed the initial drawing temperature; and *vice versâ* if temperatures of subsequent heatings are higher than that of the initial heating, the steel acquires the hardness corresponding to the maximum temperature of the subsequent heatings.

This accounts for discrepancies between the results of different authors' investigations. For instance, Taylor attached no importance to the tempering of high-speed tool steel, which may be explained by the circumstance that in his experiments the turning of steel was carried out under such conditions that the tools were heated to the temperatures of 600 deg. to 620 deg. Cent., at which the steel hardness was a result of heating involved in the work itself.

On the other hand, under the conditions of lathe work in Europe, when the high-speed steel tool is usually heated not above 300 deg. to 400 deg. Cent., the tempering of the tool to 590 deg. Cent., after quenching is absolutely necessary, for otherwise it would work at its minimum hardness.

In my practice I have reached the conclusion that steel manufacturers themselves have sometimes insufficient knowledge of the characteristics of their own steel, and, in my opinion, the method I have practised, being simple and sensible, could afford a useful means for manufacturing the best quality tool steel and for specifying the rules of its application.

Generally speaking, I think that in all the laboratory technical investigations, the most important point is to find out a method answering directly the purpose, and that there is no need to worry about its not being sanctified by a famous authoritative name, or to be carried away in looking after a universal method.

For instance, some dozens of determinations of shear strength of the weld when high-speed steel tips are welded on to tools, rendered it possible to make an exact choice of welding powder, and to define rules which were in contradiction to the opinion of experienced welders, namely:

(1) The hardening of the tools with welded tips, from the temperature exceeding that of welding, does not reduce the strength of the weld, but even raises it.

(2) It is useful for strengthening the weld of a tool in such cases to keep it for several hours at a temperature of about 800 deg. Cent.

E. HERMONIUS.

Pilsen, Czechoslovakia,
September 7th.

* Institution of Mechanical Engineers.

SCHNEIDER TROPHY VICTORY.

SIR,—In the last two sentences of your leading article of the 13th inst. on the "Schneider Trophy Victory," you very rightly stress the value of such high-speed competitions as a spur to technical progress.

High speed flying, motor car and boat races, are decried by many people as being quite useless, and it cannot be too often pointed out that this is not the case.

These races produce mechanical and other conditions of stresses which cannot be produced in any other way. The result of this provides that urge to produce more suitable materials and design to meet the increased stresses. Without such experience little progress would be made, and the benefits would not accrue in added safety in commercial machines and general advance in design.

HAL GUTTERIDGE.

London, September 13th.

FIRST ARC-WELDED BRIDGE IN EUROPE.

SIR,—The article you published in your issue of 6th inst., entitled "The First Arc-Welded Bridge in Europe," will, we are sure, attract a very considerable amount of attention.

You give in that article the name and the manufacturers of the electrodes, *i.e.*, La Soudure Electrique Autogene, of Brussels. This firm is our licensee in Belgium, and manufactures A.W.P. electrodes in that country.

We feel it is only right that any honour which is due to the manufacturer of the electrodes should be given with due consideration to the parent company, which is, as you know, and always has been, an essentially British concern.

For ALLOY WELDING PROCESSES, Ltd.,
E. H. JONES, Managing Director.
London, September 13th.

FROM a return just published by H.M. Stationery Office, we learn that the staff employed by the railway companies in Great Britain numbered during the week ended March 9th, 1929. 642,137, as compared with 677,148 during the week ended March 10th, 1928, a decrease of 35,011, or 5 per cent. The total amount of salaries and wages paid by the railway companies for the year 1928 was £117,997,000.

Atlantic Liners.*

By General E. DE VITO, Director of Naval Construction, Ansaldo Company, Sestri-Genoa.

THE author deals with the following points:—Speed, block coefficient, length, draught, breadth and stability, body plan forms, propulsive coefficient, machinery, depth, hull, deadweight, conclusions. In connection with speed he points out that, calling R the length of the single voyage expressed in nautical miles, V the service speed of the ship in knots, and T the time in hours, it is obvious that $V \times T = R$. This equation shows that time decreases according to a hyperbolic law, so that, for example, while from 20 to 22 knots the time saved may be nineteen hours, from 30 to 32 knots the time saved is only nine hours. After noting that warships are in the van of progress in speed, it is shown that for "Mauretania," "Hood," and "Bremen" the block coefficients are nearly the same. Even for modern high-speed light naval craft the block coefficient is not small; for the United States "Omaha" class of ten cruisers $\delta = 0{\cdot}61$, and for many British destoyers $\delta = 0{\cdot}54$ to $0{\cdot}56$.

The absolute value of water line length, its ratio to breadth $\left(\frac{L}{B}\right)$, and the speed length ratio $\left(\frac{V}{\sqrt{L}}\right)$ have a great influence upon the resistance of the vessel to motion. These values are arranged for four fast ships in the following table:—

	Liner "Mauretania."	Battle-cruiser "Hood."	Aircraft carrier "Saratoga."	Liner "Bremen" (unofficial).
Speed, V = knots ..	26	32	33	28
Water line length, L =	770ft.	850ft.	865ft.	930ft.
Water line breadth, B =	88ft.	96ft.	98ft.	101ft. 8in.
Maximum breadth, B_1 = ...	88ft.	104ft.	106ft.	101ft. 8in.
Breadth ratio, $\frac{L}{B}$ = ..	8·75	8·85	8·82	9·15
$\frac{L}{B_1}$ = ..	8·75	8·18	8·16	9·15
Speed length ratio, V : $\sqrt{L}$	0·94	1·10	1·12	0·92

Length to breadth ratios lie between 8 and 9, while for the fastest destroyers it is about 10.

The designed value of V : $\sqrt{L}$ is about 0·9 for liners, while for naval vessels higher values of this ratio are accepted by designers in order to avoid excessive lengths that prevent good manœuvring qualities and lead to great target area. For light cruisers and destroyers the speed length ratio is also higher, viz., about 1·4 for the former and 2·2 for the latter; for these vessels the machinery is light, so that it becomes more convenient to spend weight in obtaining more power than to increase length and weight of hull.

For fast liners the most economic solution appears to be to increase length as much as docks will allow. These vessels must run at a constant speed about 90 per cent. of trial speed, and about at full power; any reduction of this power leads to a saving of fuel.

From time to time 1000ft. liners have been prophesied; now they are an accomplished fact; and the author thinks that such great length may be surpassed, even if displacements are not increased, if still faster liners are required.

The limitation of draught is one of the most difficult points to meet, as the depths of harbour and dock entrances cannot be easily increased. Some harbours have only 26ft. draught. The "Berengaria" (ex "Imperator"), the biggest liner now afloat, draws 39ft. and she can only make use of a few harbours. To increase the depth of harbours may be an undertaking much more onerous than to lengthen docks or to build new ones.

Water line breadth remains confined between two limits: the value of the ratio $\frac{L}{B}$ suitable for speed, and the value of the ratio $\frac{B^2}{D}$ adequate for stability.

At full load and at normal load the value of the metacentric height must not be excessive, in order to have a steady ship for the comfort of passengers. If the breadth is large enough to assure stability at light displacement, stability may become excessive at load displacement.

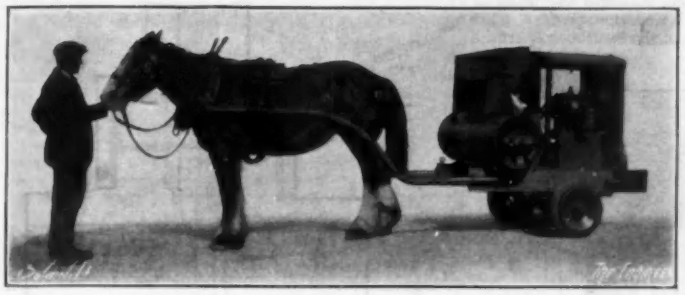
The author thinks that the simplest remedy for the conflicting conditions of positive stability at light load and of moderate stability at load displacement is to choose adequate breadths for light draught and for full load draught.

In a careful discussion of body form the author remarks that one way to reduce resistance is to use forms with special characteristics. For instance, Mr. Taylor has introduced the forward bulb; by transferring most of the volume at the bow of the ship under the water line a finer water line is obtained than with ordinary forms and resistance is reduced. Italian tank trials do not show a very great gain of speed. But Taylor's forward bulb has been adopted for "Bremen" and "Europa," and a gain of one knot is expected from it; also the latest American standard cruisers have the forward bulb; it seems that at the Hamburg and Washington tanks some advantages have been realised. Mr. Akimoff has patented the application of a bulb form to the after body in order to have aft a finer water line at water level and fuller lines under water. He says that with his model towing resistance of the bare hull, without appendages, may, perhaps, be a little greater than with ordinary forms, but he asserts that the final results of propulsion are practically improved, the screw propellers working in the wake after the hull, thus recovering the energy dissipated in the wake, and the shaft bossing being reduced. A third way to reduce towing resistance is to use peculiar forms of body plan, such as, for instance, the Maier form, the characteristic feature of which is the peculiar triangular shape of frames from end to end, combined with the wedge-shaped form of the fore and after part of the vessel.

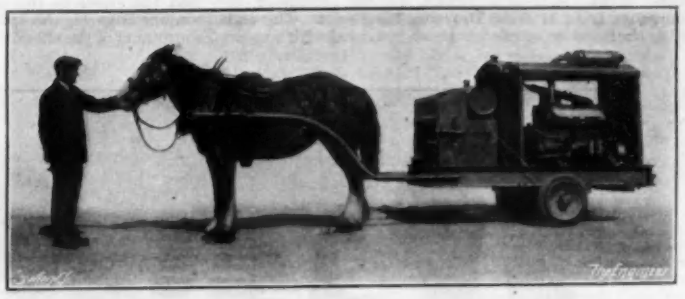
* Institution of Naval Architects, Italy. September 17th 1929. Abstract.

A PORTABLE AIR COMPRESSOR

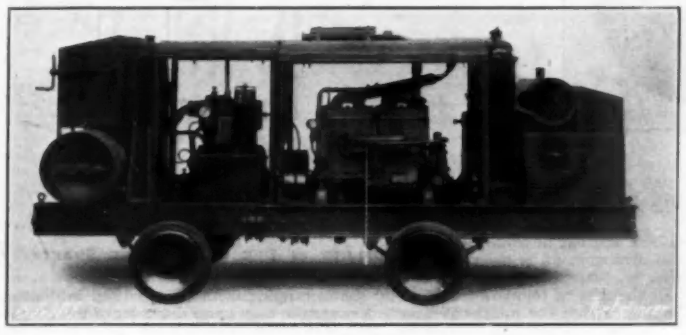
BROOM AND WADE, LTD., HIGH WYCOMBE, ENGINEERS



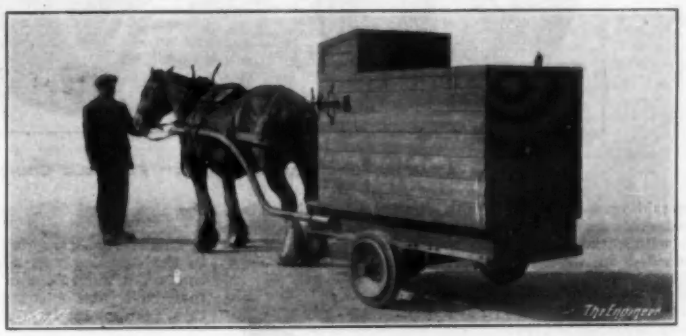
THE COMPRESSOR CHASSIS



THE ENGINE CHASSIS



THE COMPLETE COMPRESSOR



THE TOOL-BOX CHASSIS

Regarding the seagoing qualities of ships of peculiar forms, like the Taylor forward bulb or Akimoff after bulb, or both combined, the author does not think there need be any fear, provided the central portion of the body plan remains the same as with ordinary forms, and only the extreme parts fore and aft being altered.

The shell plates of "Bremen's" hull are overlapped with edges forward, with the object of producing eddies, which, according to the well-known Boerner effect, should reduce skin friction. It is claimed that a gain of half a knot is expected from this Boerner effect. This may appear rather too favourable, but, on the other hand, if the Weser Yard (Bremen) have abandoned the standard joint system for the new one, it means that they really expect some substantial gain from it.

Discussing shaft horse-power and the propulsive coefficient (P.C.), the author remarks that "Hood's" hull, notwithstanding its side bulges, has a very high propulsive efficiency compared with "Mauretania" on sea trials; it would appear that the propulsive coefficient of "Hood" must be over 0·50 at high speed. It is probable that at deep load some abnormal variations of power may occur, owing to the variation of resistance created by the immersion of bulges. Also for "Saratoga," with side-bulged forms, the results are exceedingly good, and at the highest speed even better than the "Hood" performance.

Regarding the propulsive coefficient P.C., surprising results may happen. Sometimes P.C. = 0·50 or over has been obtained from sea trials, while it was only expected to be 0·45 from experimental models—or, *vice versa*, sea trials have given P.C. = 0·46 when tank experiments had shown P.C. = 0·50 or 0·52.

Coming to machinery, the author expresses the opinion that between the 10 S.H.P. per ton of "Mauretania" and the 28 S.H.P. per ton of "Hood" there is room for a choice of suitable weight for fast liners' engines, the different conditions of service in warships and liners being taken into account. From an examination of many recent liner engines designed on the most modern lines, he has come to the conclusion that the 12 S.H.P. per ton calculated for "Europa" and "Bremen" could be increased to 16 S.H.P. per ton, when there would still remain a big margin when compared with the 28 S.H.P. per ton of "Hood's" engines.

The turbo-electric propelling machinery of "Lexington" and "Saratoga" is the most recent example for high-speed warships, but having been designed twelve years ago they are now behind the time, the steam pressure being only 265 lb., the degree of superheating very small—50 deg. Fah.—and the steam consumption 10·8 lb. per B.H.P. for the turbines only. However, the weight of the propelling machinery complete, water included, is good, about 90 lb. per S.H.P., viz., 25 S.H.P. per ton.

For high-speed liners, turbo-electric propelling machinery of 200,000 S.H.P. has been adopted both by Ansaldo and by a foreign firm independently on the same general conditions, as follows:—Screw revolutions per minute, 250; steam pressure, about 500 lb.; superheated steam temperature, 750 deg. Fah., oil-burning water-tube boilers with small tubes. The calculated results of the two independent designs were about the same, viz., total weight about 26 S.H.P. per ton, and fuel oil consumption about 0·65 lb. to 0·70 lb. per S.H.P. per hour.

Perhaps for a total shaft horse-power of 100,000 it would be advisable to reckon on heavier engines, say, of about 20 S.H.P. per ton.

An Italian firm has also considered for high-speed liners the adoption of Diesel electric machinery of 120,000 S.H.P., and also of 150,000 S.H.P. with twenty Diesel alternators and with electric motors, acting on four screw shafts. The total calculated weight was about 17 S.H.P. per ton, and the fuel consumption was reduced approximately to about 0·5 lb. per S.H.P. per hour. To avoid the difficulty of the parallel running of alternators the adoption of five electric motors, working in tandem, on each shaft, was also considered, so that each of the twenty electric motors was fed independently by one alternator, as preferred for electric propulsion. An alternative solution consists in the series connections of motors and generators acting upon each screw.

A German firm has designed propelling machinery of 120,000 S.H.P. for a liner with twenty high-speed Diesel motors acting through Vulcan gears on four screw shafts. The Diesel motors were of the two-cycle double-acting type with nine cylinders of 21in. by 27in., developing 6300 B.H.P. at 250 revolutions. Screw revolutions, 210 per minute; each of the two outer shafts being actuated by four motors—24,000 B.H.P.—and each of the two inner shafts by six motors—36,000 B.H.P. Each outer shaft had a Vulcan gear, and each inner shaft had two. The total weight, circulating oil and water included, was about 165 lb. per S.H.P., or 13·5 S.H.P. per ton, against 8 S.H.P. per ton of "Berengaria" (ex "Imperator").

New designs deserve consideration, but at present the author is inclined to think that standard propelling machinery may be represented by geared turbines, oil-burning, high-pressure, small-tube boilers and superheated steam.

In all cases when comparing the weights of different types of machinery the required weight of fuel oil for the whole trip should be considered.

In conclusion the author says:—"I have touched upon points of great interest in the study of high-speed liners. As I have had the opportunity of considering this important question during these last three years, I may be pardoned if I express here my personal opinions. The policy followed by the majority of British and German owners in building new fast liners seems to be in the direction of larger displacement. Perhaps they are right for commercial considerations, otherwise I think that high speed can be obtained without running into increased displacement. To effect this I think it is necessary to renounce double bunkering; to reduce from 20 per cent. to 10 per cent. the fuel oil reserve; to use the most economical engines with a fuel oil consumption under 0·7 lb. per S.H.P.; to use the lightest engines compatible with the aforesaid condition of economic working, which I think is possible even at the rate of 20 S.H.P. per ton; to use special body forms, such as naval forms or even the Maier form, to reduce shaft horse-power, with a water line length suitable to high speed, regardless of actual dock limitations; to develop longitudinal structure to its maximum efficiency and extent; to use extensively special steel with a high limit of elasticity—such as Colville steel and similar qualities—for all the structural hull; to reduce passengers to first class alone, for instance, 400 passengers, considering express liners as express trains; to reduce the weight of outfits, auxiliaries, accessories, and passenger fittings, using cast steel instead of cast iron, special bronze castings instead of ordinary ones, and special light alloys as is done in the most recent light warships, and to develop electric welding for structural connections; to use evaporating and distilling apparatus of high efficiency in order to reduce fresh water. In my opinion high-speed liners ought to be racehorses and not elephants."

Portable Air Compressor for Greece.

In order to overcome transport difficulties, Broom and Wade, Ltd., of High Wycombe, have made up a portable compressor in the manner illustrated by the illustrations above. It will be seen that the compressor chassis and the engine chassis are built as separate units to which tubular shafts can be readily attached. On arrival at the site of operations the two parts are coupled together, two long bearer bars of large diameter mounted on the engine chassis fitting into sleeves on the compressor chassis to ensure alignment. An additional two-wheel chassis carries the tool-box containing the rock drilling or road breaking equipment.

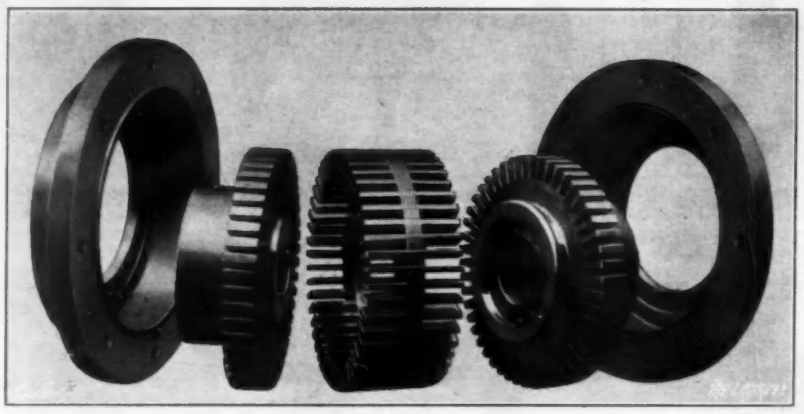
The plant itself follows pretty closely the ordinary design of the manufacturers. It is capable in this case of operating two heavy duty road breakers simultaneously or two rock drills for hard rock and was supplied to the order of the Greek Ministry of War.

SIXTY YEARS AGO.

In our issue of September 17th, 1869, our Birmingham correspondent gave some particulars of the work and organisation of Soho. The famous establishment now forms part of Messrs. Avery's works, but sixty years ago the firm owning it was still known as James Watt and Company, the actual proprietors being Mr. H. W. Blake, of London, Mr. Gilbert Hamilton, of Leamington—a grand-nephew of Watt—Mr. Charles Barclay, of London, and Mr. James Brown, of Birmingham. The establishment occupied an area of about twenty acres, and all its workshops were at ground floor level. It comprised two main sections, the Mint and the engineering department, and gave employment to about 1200 people. Describing a visit which he had paid in Mr. Hamilton's company to the Mint, our correspondent mentioned first the copper store, an underground cellar dimly lit by torches, securely fortified against possible invasion, and capable of holding 1000 tons of ingots. In an adjoining mixing shop the materials—copper, zinc and tin—for the production of bronze were apportioned ready for the casting shop, a department furnished with thirty pot furnaces and three air furnaces. The mixture was melted in Stourbridge crucibles of 120 lb. capacity, and the total produce was about 12 tons a day. The bronze was cast into slabs about 2ft. long by 4in. wide and 1in. thick. The slabs were rolled to the required gauge by passing them through four pairs of rolls, the last of which could be regulated to the ten-thousandth part of an inch. During the rolling process the strip was annealed, scoured and washed in vitriol, and when it was finished the strip had a bright and polished surface. Eight steam presses were employed to cut round blanks from the strip. The presses had multiple dies and produced 450 to 500 blanks a minute. The blanks were then taken to the milling machines, of which there were fourteen, and which by a simple and rapid process raised the edges of the coins. Before being coined the blanks were annealed, pickled, washed and shaken in a steam driven barrel, and finally picked for defects in form or colour by girls. For certain countries the blanks represented the finished stage so far as Soho was concerned. The Home and Colonial Governments and several others, however, entrusted the works with the actual stamping of the coins. The coining presses were twelve in number, and were worked on the pneumatic principle invented by Matthew Boulton. Each press could mark from 80 to 150 coins a minute. Our correspondent recorded that the first contract for bronze coins entrusted to the establishment by the British Government was for 720 tons of pence, 48 to the pound weight, 880 tons of halfpence, 80 to the pound, and 120 tons of farthings, 160 to the pound. No explanation was given why the pennies should have been made disproportionately light. The Soho works produced coins not only for Great Britain and the British Empire, but also for the "new kingdom of Roumania," for Honduras, Turkey and other countries. It would not, however, manufacture "cash" for the Chinese Government. "Cash," our correspondent said, were composed chiefly of the refuse metal discarded by Birmingham manufacturers, and were beneath the quality of Soho produce.

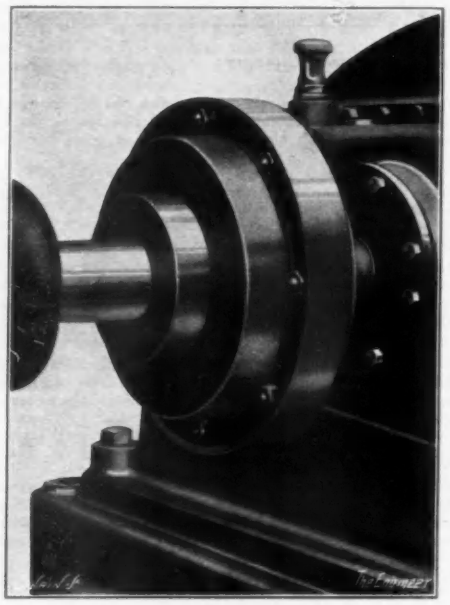
The "Carrier-Ring" Flexible Coupling.

THE flexible coupling illustrated herewith is a new device made under McLeod's patent by the Power Plant Company, Ltd., of West Drayton, Middlesex. The ends of the shafts to be coupled are each provided with a spider



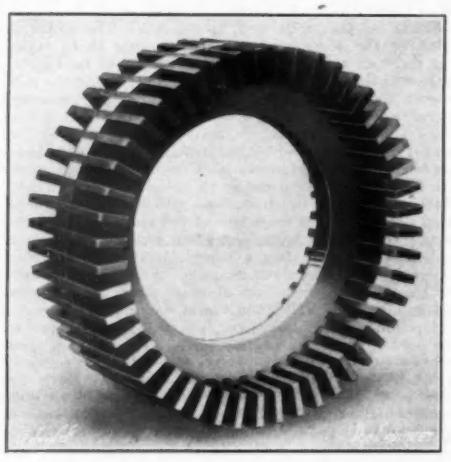
ELEMENTS OF "CARRIER-RING" FLEXIBLE COUPLING

resembling a spur wheel with deeply cut teeth. These spiders are united by a number of flat steel springs, which fit within the gaps of the spider teeth and which are mounted on a central carrier ring to constitute a single



COUPLING APPLIED TO A MOTOR DRIVE

unit. Two cover rings bolted together embrace and enclose the two spiders and the carrier unit. It will be observed on inspection that the gaps between the spider teeth are not parallel sided, but are shaped to a parabolic contour.



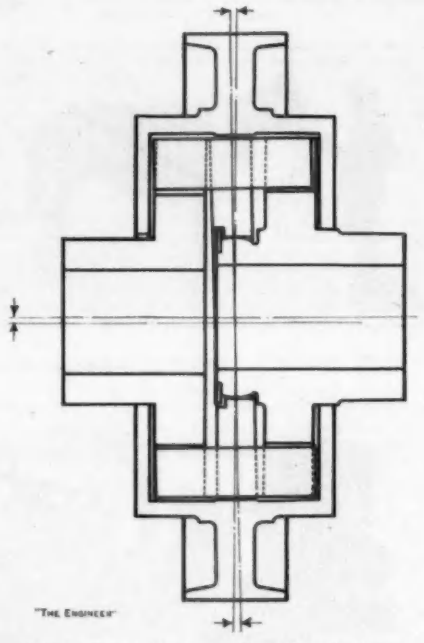
CARRIER-RING ELEMENT

The wider ends of the gaps in both spiders face towards the carrier ring. It will also be observed that the bore of the carrier ring rests on a spherical seating formed on one of the spiders, and that the carrier ring has a certain amount of freedom on this seating between a face on the spider and a retaining ring applied to the end of the spider boss.

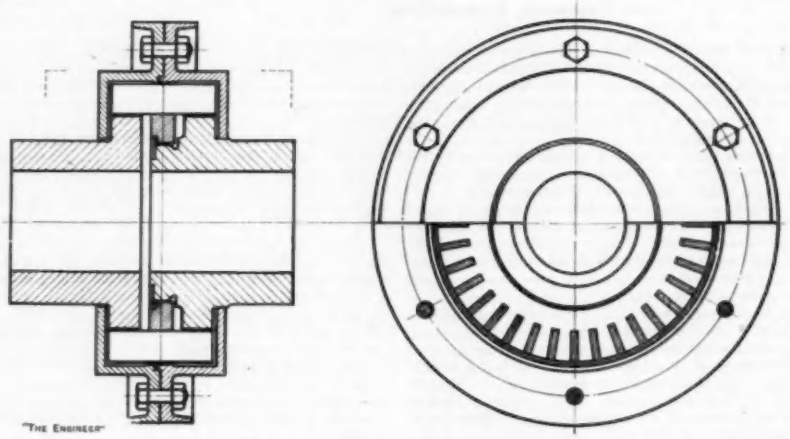
Each spring on the carrier ring forms in effect two separate cantilevers. Under load the cantilevers on the two sides of the carrier ring deflect in opposite directions. As the form assumed by a cantilever when deflected under load is a parabola, and as the tooth gaps in the spiders are of parabolic contour, it follows that the higher the load the closer to the carrier ring becomes the point of contact between the spider teeth and the springs. This shortening of the effective length of the cantilevers permits the higher load to be carried without an increase in the stress in the springs.

This construction gives the required angular flexibility to the coupling. In addition, the arrangement is such that axial movement of the shafts, as, for example, by their expansion or contraction with changes of temperature, is accommodated by the coupling within the limits provided by the cover rings and the spiders. Further, as will be gathered from two of the accompanying sketches, the coupling can accommodate itself, by virtue of the spherical seating of the carrier ring, to two shafts misaligned either by being slightly offset or slightly inclined to each other. The working faces of the coupling are all highly finished, and provision is made for lubricating them automatically by the application of grease under pressure.

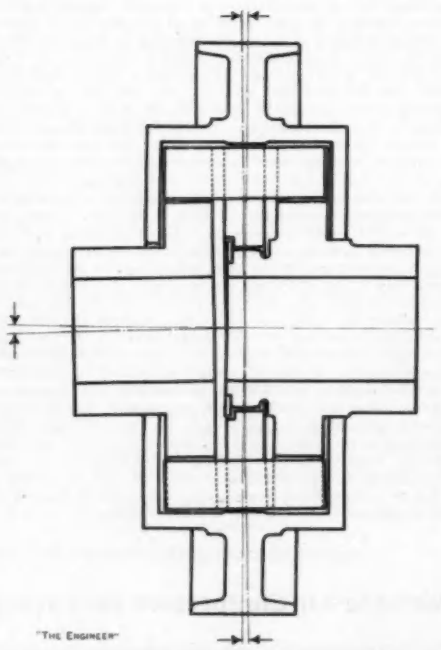
The coupling is made in various sizes to transmit steady torques equivalent to those which can be safely transmitted by shafts ranging from 1in. to 12in. in diameter. Within this range the maximum diameter of the coupling, over the cover rings, extends from 6½in. to 44in., and the overall length from 3½in. to 27½in. The number of springs employed varies with the size of the coupling. In the 1in. size there are 24 springs, and in the 12in. size there are 80. The weight of the coupling ranges from 19 lb. to 5200 lb.



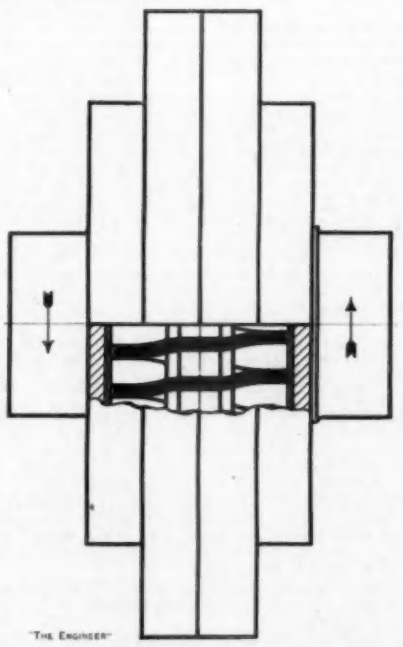
COUPLING IN USE ON OFF-SET SHAFTS



GENERAL ARRANGEMENT OF COUPLING



COUPLING IN USE ON INCLINED SHAFTS



COUPLING UNDER LOAD

RIVER WORKS AT LANGFORD.

HITHERTO Southend has been supplied with water pumped from no less than thirty-four wells, and the demand is increasing. The district covered by the Southend Waterworks Company is 160 square miles in extent. It is bounded on the north by the river Crouch, on the south by the Thames, and on the west it extends almost to Brentwood, but the company is under obligations to furnish supplies in bulk to a further area of 164 square miles. In these circumstances some more satisfactory and economical source of supply than wells had to be found, and in 1924 powers to abstract water by separate intakes from the rivers Chelmer, Ter and Blackwater were secured. These rivers will give a daily supply of 7 million gallons which, with the water drawn from the existing wells, should meet the estimated needs for many years to come.

The River Works are at Langford, and were officially opened by Brigadier-General R. B. Colvin, Lord-Lieutenant of the County of Essex, on Wednesday last, September 18th. They comprise a reservoir, a pumping station and purification works. There are, of course, the usual weirs, intakes, &c.

The three rivers flow through sparsely populated agricultural districts, and the Ter is a tributary of the Blackwater. On the Chelmer the intake is above Rushes Lock, and on the Blackwater at Langford Mill, close by the confluence of the two rivers at Beeleigh, which is just above the estuary. Here in the angle formed between the two rivers the reservoir, pumping station and treatment plant have been erected. Water from the intake at Rushes Lock, 2¼ miles away, falls by gravity through a 33in. pipe into the reservoir. This reservoir covers an area of some 10½ acres, and is built in two parts each having a capacity of thirty million gallons. The raw water descends from the reservoir to the pumping station which sends it to the purification works, from which it gravitates through a covered equalising reservoir of 500,000 gallons capacity back to the station, and is pumped through a 28in. main to the Oakwood Service Reservoirs, which lie some fourteen miles away. The main passes through a tunnel 32ft. beneath the bed of the Crouch. In the pumping station there are two vertical triple-expansion rotative pumping engines, built by the Lilleshall Company, Ltd., each of which can deal with four million gallons per day. Another engine of the same size will shortly be erected. Steam at 210 lb. and 150 deg. Fah. superheat is provided by two Babcock and Wilcox boilers, and a third generator of the same size is to be put in. The boilers have chain grate stokers. The electrical supply for lighting and power is derived from three 80 kW steam sets by Belliss and Morcom, Ltd.

Purification is effected by the familiar excess lime process after sedimentation in the storage reservoir for eight or nine days. The treatment and filtration plant was made by the Paterson Engineering Company, Ltd., and the lime recovery plant by Edgar Allen and Co., Ltd.

The works as a whole were designed by, and carried out under the supervision of Messrs. T. and C. Hawksley and Mr. E. C. Bilham, and about one million pounds has been expended on them.

CATALOGUES.

HADFIELDS LTD., Sheffield.—Pamphlet No. 293 on "Galahad" stainless iron and steel.

STEIN AND ATKINSON, Ltd., 47, Victoria-street, S.W. 1.—The first edition of "Modern Industrial Furnaces."

LUNKEN COMPANY, Ltd., 35, Great Dover-street, S.E. 1.—A leaflet on Dr. Föttinger's improved torsionmeter.

MOSS GEAR COMPANY, Ltd., Tyburn, Birmingham.—List No. 14 of automobile gears, units and components.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Publication 249 on "Prescot" terminal boxes and sealing ends.

ALLOY WELDING PROCESSES, Ltd., Ferry-lane Works, Forest Row, E. 17.—Bulletin 61, "Conclusive Welding Tests."

HEAD, WRIGHTSON AND CO., Ltd., Norton-road, Stockton-on-Tees.—Particulars of the "Buzza" pneumatic vibrating screen.

THOS. W. WARD, Ltd., Albion Works, Savile-street, Sheffield.—A booklet giving particulars of a new Portland cement works at Ketton.

EXORS. OF JAMES MILLS, Ltd., Bredbury, near Stockport.—Details of grooved pins for replacing set screws, stop pins, dowels, studs, &c.

F. J. EDWARDS, Ltd., 406, Euston-road, N.W. 1.—Latest stock list of new and reconditioned sheet metal working machinery of all types.

W. CROCKATT AND SONS, Ltd., 62, Darnley-street, Glasgow.—A booklet describing the "Crockatt" simplex electric salinometer for indicating any impurity in condensate and boiler feed water.

JAMES KEITH AND BLACKMAN COMPANY, Ltd., 27, Farringdon-avenue, E.C. 4.—"The K-B Gas-fired 'Challenge' Boiler," "Blackman Volume Fans," "Induced Draught and Flue Dust Arresting."

CONSTRUCTIONAL ENGINEERING COMPANY, Ltd., Charles Henry-street, Birmingham.—Leaflets dealing with "Titanite" stone mixture for patternmaking and the "Pournay" system of cupola control.

GENT AND CO., Ltd., Faraday Works, Leicester.—Book 7, Section 56, on the "Staff Locator" for calling and locating members of the staff. Section 4a, "The Unification of Workman's Recorders."

CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., 170, Piccadilly, W. 1.—S.P. 137, a loose-leaf booklet illustrating the applications of pneumatic tools to various industries. S.P. 139, "Air and Electricity in the Automobile Industry."

CLAYTON FORGE.—Clayton Forge, Lincoln, was erected only a few years ago for the mass production of all sorts of forgings for motor vehicle, railway and general engineering. It has a very complete equipment of shops for drop forging, smithing, die-sinking, toolmaking, &c., enclosed in a large new building some 350ft. long and nearly 300ft. wide, with a separate shop for pickling and heat treatment. The whole establishment is, we are informed, now for sale by tender by Henry Butcher and Co., Chancery-lane, London. Tenders must be in by Monday, September 30th next.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

As September advances inquiries for autumn supplies of material become more numerous, and producers of iron and steel are enabled to calculate roughly the probable demands likely to be made upon their resources during the remaining three months of the year. The uncertainty of the raw iron market is hindering matters somewhat, but the general opinion is that the majority of the works in this area will be more than usually active. Iron and steelmasters, manufacturers, and engineers both heavy and light, are looking forward to brisk industrial conditions, and contracts alike for work and material should develop, if present favourable conditions continue, within the next few weeks. The quarterly meeting of the Midland iron trade, which will be held early in October, is likely to prove the culminating point in the autumn buying campaign.

Pig Iron.

The unsettled state of the pig iron market persists. The past week has provided no enlightment for smelters as to future supplies of furnace coke, consequently users of pig iron are still in the dark as to the extent of the probable rise in iron prices. That iron will be dearer in the near future there seems little doubt. How much it will be necessary to add to present selling rates to compensate smelters for increased production costs and to assure profitable production provides an, at present, unsolved problem. Developments hang on the price of coke. Ovenmen who had coke to spare this week wanted a large premium over the 16s. 6d. lately quoted for blast-furnace coke. Very little is to be had, however, this year's output being reported as practically all sold. There was talk amongst furnacemen on 'Change in Birmingham today of slowing down production in order to conserve supplies of coke. The question of limiting forward commitments was also under consideration. Moderately large sales have been made over the next three months, and smelters are disinclined to go beyond that period. At date Derbyshire No. 3 foundry is quoted £3 16s., and Northamptonshire £3 12s. 6d., but a revision of quotations is expected at any moment. The position is being closely watched by all parties concerned.

Staffordshire Bar Iron.

Staffordshire bar iron makers speak hopefully of the autumn prospects. If conditions remain as at present, industrial activity should be maintained at any rate at the existing level during the rest of this year. It is hoped, naturally, that next month will bring such an accession of business that output will have to be increased. The long spell of hot weather has interfered to some extent with output at the puddling furnaces and mills in the Black Country, and deliveries of material to these works have fallen into arrear. Bar iron prices are, up to the time of writing, unchanged. Marked bars are in good demand at £12 per ton, while Staffordshire Crown iron is quoted £10 upwards. Keen competition still characterises the trade in Crown bars. Nut and bolt and fencing iron at £9 per ton upwards fails to compete successfully with Belgian No. 3 bars available at £6 15s. Strip continues to sell well, the raising of the price to £11 2s. 6d. per ton having had no appreciable detrimental effect upon sales. Black Country tube works are still moderately busy.

Steel.

Finished steel is in moderate but growing request, and Midland producing works are fairly well employed. Several of the large Midland constructional engineering firms report better business, and improved prospects. They hope to consume, in the near future, considerable tonnages of material. The demand for plates is of medium moment. Prices of all finished material are unchanged from last week. Practically all the available business is being secured by native steelmasters, continental competition in this branch not proving really serious. In the semi-finished steel department, however, matters are rather different, and fairly large consignments of foreign small bars and billets are coming into this district. There has been some falling off in foreign business this week owing to advances in quotation of continental material. Local makers have not varied their quotations for bars and billets neither have Welsh steelworks competing in this market. Staffordshire ironmasters whose plant is engaged in re-rolling steel are securing quite a good proportion of the business in existence. They compete most successfully with the steelworks.

Galvanised Sheets.

Conditions continue to improve in the galvanised sheet department. Added to the rush to get consignments to South Africa while advantageous freights are in operation, have been some orders from Palestine. Inquiries from South and Central America have so far proved disappointing. Some liveliness in the near future is, however, anticipated. The understanding among manufacturers of sheets that quotations of 24-gauge galvanised corrugated sheets should not go below £13 7s. 6d. is not, apparently, been adhered to, for offers to supply at £13 5s. are this week reported. Some firms which still have a good amount of business on their books refuse to accept orders below £13 10s., while the most fortunate concerns quote as high as £13 15s. Most mills could now do with fresh orders, as new business is not coming in at anything like a fast enough rate to counterbalance the orders being completed.

Scrap.

Very little heavy steel scrap is changing hands at present, consuming works in many cases having sufficient material in stock to last some little while. Birmingham merchants' offers of supplies at £3 15s. per ton have this week been turned down by South Wales works. The reduction of 1s. per ton on last weeks' minimum is considered insufficient to tempt users to make fresh purchases under existing conditions.

Suggested Railway Electrification Scheme.

Under this heading in my letter of June 21st I made reference to the steps being taken to induce the London, Midland and Scottish Railway Company to electrify the branch lines between Coventry and Leamington and Coventry and Nuneaton. After consideration of the suggestions put forward the company now states that the heavy expense which would be involved would not, in its opinion, be justified by results. It considers the existing arrangements adequate for present requirements.

Satisfactory Output.

Iron and steelmasters in the Midlands regard the production statistics for the month of August as very satisfactory. In the pig iron department an increase over the July output was hardly anticipated, but such proved to be the case. Production amounted to 682,000 tons, compared with 671,900 tons in July and 519,000 tons in August, 1928. The number of furnaces now in blast is three in advance of the number operating a month ago, the total for the Kingdom as a whole being 170. It is noted that of the total pig iron produced 140,200 tons were foundry material, 26,700 tons forge, 206,900 tons hematite, and 280,100 tons basic. The August output of steel ingots and castings—753,300 tons—while in advance of the production in August, 1928, was a little more than 51,000 tons below the July output.

Work for Midland Firms.

Midland firms continue to secure some excellent orders. Amongst the latest received are an order for 132 kilovolt overhead transmission lines by the General Electric Company, Ltd., of Witton, Birmingham, required by the Central Electricity Board in connection with the Mid-East England scheme; one for four locomotives by the Sentinel Wagon Works, Ltd., of Shrewsbury, required for the Cauvery-Metur Hydro-electrical scheme; and orders for single and double-deck omnibuses for the Newcastle-upon-Tyne Corporation, awarded to Guy Motors, Ltd., of Wolverhampton, and the Daimler Company, Ltd., of Coventry.

Severe Competition.

The severity of competition in the steel window and patent glazing industry is such that, although the well known Smethwick firm of Henry Hope and Sons, Ltd., last year experienced record sales, the rate of profit earned was lower than it has ever been before. During the past year a strenuously fought price war was waged in the patent glazing industry, but common-sense lines of business have now been resumed. In the steel frame industry home and foreign competition remains very severe and some firms are known to be accepting business at a price which can only reap a loss. Mr. H. Donald Hope, chairman of the above named company, recently pointed out that one of the worst results of unbridled competition was the premium placed upon the production of cheap rubbish, to the demoralisation of the trade. He feared that real harm had already been done to the steel window industry, as it was reported that several public authorities had gone back to wooden windows for large housing schemes after a bad experience with steel windows purchased from the lowest tenderer.

Overseas Trade.

Industrialists here comment upon the fact that the statistics of overseas trade for the month of August show a decline in both exports and imports of iron and steel when compared with the same month of last year. The value of the iron and steel and manufactures thereof reported last month was £5,572,539, against £5,941,852 a year ago, a drop of £369,313. Imports of iron and steel were valued at £2,165,785, compared with £2,195,148 in August last year. It is noted that there was an increase in exports of vehicles amounting to £1,301,481, of electrical goods amounting to £302,244, and of non-ferrous metals and manufactures amounting to £232,447. Midland manufacturers of goods which come under the vehicles group and of electrical goods, are particularly well pleased with the month's returns.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Sharp Fall in Textile Machinery Exports.

THE only satisfactory feature about the August shipments of textile machinery is that they represent a slight increase over the corresponding month of 1927. Compared with July of the present year, they make a particularly poor showing, for the total value is lower by not much short of £400,000, although it is true that the July figures were the highest recorded for some time. Compared with August, 1928, however, last month's shipments were down in value to the extent of about £63,800. Of the 10,014 tons of textile machinery, valued at £905,034, exported during the month under review, 7996 tons and £691,922 represented spinning and twisting machinery, and 1491 tons and £133,607 weaving machinery. Except to Japan, whose takings are maintained at a satisfactory level, and to South America and Australia, shipments showed a heavy decline to all markets compared with the previous month, particularly to British India and Russia. India is still the largest individual market, but Russia, instead of being an easy second, as she was a month ago, is now at the bottom of the list. Exports to British India during August reached a total value of £242,185, with Japan second with £106,936, followed by South America

with £67,339, France £59,956, the United States £48,502, China £46,725, Germany £40,337, the Netherlands £34,146, Australia £24,835, and Russia £18,629 ; shipments to other European countries reaching an aggregate of £157,131, against £205,046 in the previous month.

Northern Exhibition Homes.

Two projects which have followed closely one upon the other have, apart from their more general interest, a close interest for constructional engineers, for they will represent, if both are ultimately proceeded with, important additions to work to be undertaken in the near future. The earlier one is of more particular interest to Manchester's near neighbour, Salford. It is proposed to erect on a site in Cross-lane, Salford, what is described as a Northern Olympia, and a limited company under that title has been registered with an authorised capital of £500,000. The intention is to build an exhibition hall larger than Olympia, London, having a clear floor area under a one-span roof of 625ft. by 230ft., compared with the London hall's area of 175ft. by 450ft. Sir E. Owen Williams, who acted in a similar capacity for the British Empire Exhibition at Wembley, has been appointed engineer. Announcement of another ambitious scheme was made on Tuesday of this week. This relates to the erection of an eleven-storey hotel, an exhibition hall—also larger than London's Olympia—and a sports club, at an aggregate cost of about £1,000,000. The site is in the centre of Manchester, covering an area of 20,000 square yards, with a frontage in Lower Mosley-street, and facing the side of the Central Station.

The New Mersey Tunnel.

The recommendation of the engineers in charge of the scheme to widen the aperture of the four entrances of the new tunnel between Liverpool and Birkenhead underneath the river Mersey to a width of 200ft. by 20ft., has been adopted by the Mersey Tunnel Joint Committee. This increase will permit of a further line of traffic. The construction of the tunnel, of which the total estimated cost is £5,250,000, was started about four years ago, and satisfactory progress is being made. It is stated that more than 26,000 tons of cast iron lining have already been put into position.

Closing an Ironworks.

A final decision to close down the greater portion of the Globe Ironworks, Stalybridge, has been arrived at by the board of directors of John Summers and Sons, Ltd., after an unsuccessful intervention by the Mayor of Stalybridge. The sheet metal and galvanising departments are the sections affected, the bar mills and the nail department being retained. Ultimately, about 800 men will be thrown out of employment, although the company states that an effort will be made to find employment for a proportion of the men affected at its works at Shotton, near Chester.

Non-ferrous Metals.

Taking the non-ferrous metals generally, trading has been by no means active during the past week. Apart from copper, however, which has experienced a rather severe decline, the tone of the other sections has been steady to firm. The ups and downs in copper that have taken place since my last report have been due almost entirely to speculative influences in one direction or another, although up to last week-end there had been little change on balance. In the early market sessions of the present week, however, the tendency has been distinctly bearish, and prices at the moment of writing have lost the whole of the gains of the two previous weeks. Trade consumers of the metal have been operating on cautious lines, and, on the whole, transactions have been moderate. In the case of tin also the demand has been rather slow, but prices have firmed up and are dearer to the extent of about 20s. per ton compared with a week ago. There has been a moderate amount of business passing in the spelter section, and in accordance with the experience of the past few weeks, the tendency has been again easier, although current quotations are only fractionally lower on balance. Lead has met with a fair demand, and is now back again to where it was a fortnight ago, last week's loss of 5s. per ton having been recovered.

Iron and Steel.

From the point of view of new forward buying conditions on the foundry iron market here this week have been somewhat more active, a fair number of contracts having found their way on to Midland ironmasters' books. Steady deliveries are being taken by local foundries, and altogether pig iron seems to be in a "bullish" position, so much so that an advance in prices as a result of the meeting of producers during the coming week would not altogether come as a surprise. Derbyshire makes are quoted at 74s. 6d. per ton for delivery in the Manchester zone and Staffordshire at 75s. 6d. A quiet trade is being done in Scottish iron and in hematite at about 93s. and 87s. 6d. per ton respectively, including delivery to Manchester users in each instance. There has been no change in the position of manufactured iron. Demand in this section during the past week has been very moderate, but quotations are maintained at £10 15s. per ton for Lancashire Crown bars and £9 15s. for No. 2 material. There has been a good deal of market speculation as to whether this week's meeting of steel producers will raise the schedule prices above those fixed at the May meeting. The general view is that no alteration will be made, and on this occasion, although there has certainly been a moderate weight of new buying activity, it has not been of the volume of previous occasions when the price question has been prominent. On the whole, contract deliveries of steel to consumers in this area are not unsatisfactory. Rerolled bars appear to be fairly steady at the moment at from £8 5s. to £8 7s. 6d. per ton, according to quantity, with joists at £8 2s. 6d., general plates at £8 17s. 6d., large bars at £9 2s. 6d., and boiler plates at about £9 17s. 6d. The market for imported materials has displayed no further weakness during the past week, but the demand locally has been restricted.

BARROW-IN-FURNESS.

Hematite.

There is a steady demand for hematite pig iron on general home account. At Workington there is a fair demand, but there is no outlet at Barrow. There have been no movement in prices of late. Prices do not leave much margin of profit, and keen competition is being experienced by makers from the East Coast.

Iron Ore.

For hematite iron ore there is a good steady demand on the part of local smelters, and ore is being sent to the East Coast and Scotland. The importations of foreign ores are quiet.

Steel.

The demand for steel rails is quiet all round, and there are no signs of any revival, either on home or overseas account. At Workington the orders in hand only keep the plant going three weeks out of four, and this situation is likely to continue for the next two months or so. At Barrow steel production ceased a few weeks ago, the only activity being in the rolling of steel hoops, mostly for overseas.

Shipbuilding and Engineering.

There are no new features to note in these trades. Vickers-Armstrongs will shortly launch from their Barrow yard a submarine depôt ship for the Chilean Navy.

Fuel.

There is a steady demand for fuel, both coal and coke.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Hopes.

IT is confidently hoped that the turning point has been reached so far as the position of the steel industry of the Sheffield district is concerned. Recently conditions have been extremely dull and even worse than those usually experienced at this period, which is the slackest of the year, but there are distinct indications that an improvement will not be long delayed. Order books justify this optimism, although many firms are still finding business anything but brisk. The basic steel departments continue to be active, and for acid steel the demand remains poor. There has been a better call for railway materials recently, but the requirements of the British companies are on a considerably reduced scale, while overseas work is not of satisfactory proportions. Satisfaction is principally derived from the strengthening demand for special steels. Important metallurgical developments have occurred, and the requirements of engineers, so far as high-class steels are concerned, which have changed considerably, are being met by Sheffield manufacturers. Local manufacturers are also supplying large quantities of special alloy steels, which combine lightness with strength and resistance to corrosion, for the construction of aircraft. The requirements of motor car makers, for steel parts and tools have decreased in value since the beginning of the year, but there has been an increased call for parts for heavy vehicles, such as omnibuses and char-à-bancs.

Trade with the Argentine.

Considerable satisfaction is felt in Sheffield with the results of the work of the British Economic Mission to Argentina, and the negotiation of a provisional agreement between the two countries. It is proposed that in exchange for Argentine products Britain shall supply materials to the extent of approximately £8,000,000 required by the Argentine Government for railways and public works. As Sheffield is one of the principal centres in the country for the manufacture of railway material, the news is extremely welcome. A considerable trade is already done with the Argentine, but local firms have suffered very badly recently from foreign competition. It is expected that a good proportion of the £8,000,000 will be spent on axles, wheels, tires, buffers, rails and other railway material in which Sheffield specialises.

Meeting Modern Needs.

The increasing utilisation of higher temperatures and pressure in all branches of industrial activity is opening up a wide field of application for new steel products. Great strides have been made, and are still being made, in the manufacture of special tool steels for machining operations. Modern tool steels, especially those used in shipbuilding yards and boiler shops, must have two outstanding properties—they must be highly efficient and easily manipulated. Recently, also, designers of internal-combustion engines, and steam turbines, as well as chemical engineers, have been calling for material with considerable strength at high temperatures to resist the attack of various chemicals and also extreme heat and cold. It is in the manufacture of such materials that the greatest developments in steel metallurgy have recently taken place. Edgar Allen and Co., Ltd., Sheffield, have been to the forefront in these developments. Hadfields, Ltd., have also been very active, and can now exhibit an alloy capable of being utilised at temperatures up to 1200 deg. Cent.

The Lighter Trades.

The demand for cutlery and plate is below the standard for this time of the year, while business in tools and other finished steel products is extremely quiet. Considerable interest has been aroused by views in favour of rationalisation of the lighter industries expressed by Mr. W. C. Veall, of Sheffield Cutlery Manufacturers, Ltd. He suggests that when one thinks of the multiplication of works and manufacturing, clerical and distributive expenses, it is not difficult to account for failures that have occurred in the past. What is wanted, he contends, is centralised manufacture and centralised selling arrangements to give the public, the retailer and the manufacturer equal benefits.

Hope Valley Cement Works.

The cement works in the Hope Valley, near Sheffield, which have just been completed by G. and T. Earle, have been described by American visitors as the finest in the world. They have been erected during the last eighteen months, and are planned to produce 3200 tons of Ferrocrete cement per week. The principal raw material, limestone, is quarried along a rock face 700ft. to the south of the works, and a few days ago the first big blasting operation was successfully concluded. The work of drilling bore holes to take charges of gelignite was carried on by seventy men for about six weeks. The blast was entirely satisfactory, and yielded as much material as will justify an early start with the work at Hope, where 4000 tons of limestone will be used every week. At the works is the largest jaw crusher in the country. Standing on a 9ft. bed of reinforced concrete and weighing 146 tons, this crusher is capable of dealing with lumps of rock up to 6ft. by 4ft. It is fitted with Ross chain feeders at entry and discharge, and with jaws and plates of manganese steel, and can crush the rock to pieces 6in. and under. A cone crusher, also the largest of its kind in England, is also installed.

Ewden Valley Waterworks.

Mr. Arthur Greenwood, Minister of Health, is shortly to open the newly-completed waterworks of the Sheffield Corporation in the Ewden Valley. This undertaking was begun in 1913, and has cost about £1,700,000. The works comprise two large impounding reservoirs, a service reservoir, and twelve miles of trunk mains. The Broomhead reservoir, which is the larger one, controls a drainage area of 5427 acres, and has a storage capacity of 1142 million gallons, with a surface area of 122 acres and a depth of 93ft. The length of its embankment is 1000ft., the width at the base 594ft., and at the top 20ft., and the height above the river bed is 100ft. It is formed of earthwork, the inside slopes being 3 to 1 and the outside 2½ to 1, and contains 650,000 cubic yards of material. The second—More Hall—reservoir has a drainage area of 1069 acres, and a total capacity of 480 million gallons, covering 68 acres. Its embankment is 920ft. in length and 80ft. in height above the river level.

NORTH OF ENGLAND.

(From our own Correspondent.)

Coal Trade Setback.

A SHORTAGE of ships and wagons for dealing with the output has proved a serious setback to the expansion of the Northern coal trade during the past few days, and colliery owners have passed through a harassing time, as they have been unable in many instances to fulfil their commitments. A number of pits have had to cease work because their output could not be handled, and many Durham collieries are now working short time. The position, however, is not so acute as it was at the end of last week, when hundreds of wagons full of coal were lying at the staithes awaiting unloading into ships which were not available. More vessels have come forward this week, but full working at some of the pits cannot be resumed until more wagons are returned. The railway companies have been blamed in certain quarters for not having more wagons available, but it should be understood that the present number proved sufficient when the vessels were awaiting and unloading the wagons. Some exporters declare that they have hardly dared to accept new orders, in view of the transport difficulties, and merchants have been selling coal at considerably reduced prices to get it taken away from the pits for the sake of keeping them working.

Cleveland Iron Trade.

There is a steady flow of business in the Cleveland pig iron trade, and the general volume of inquiries justifies confidence in the future. Among the contracts secured are some for delivery over periods well into next year. Current prices, however, yield but little profit. Rising costs of raw materials warrant a substantial advance in prices, but movement in that direction might reopen to continental competitors markets that have gradually been regained by Teesside firms. Growing needs promise to necessitate further enlargement of the pig iron output if quotations keep in the neighbourhood of terms at present accepted. There are virtually no stocks to hamper Cleveland iron producers, and they firmly adhere to the fixed minimum prices that have ruled for several months, though buyers endeavour to obtain price concessions. Prompt parcels are still difficult to purchase, and readily realise well above the recognised minimum prices. No. 1 Cleveland foundry iron is 75s.; No. 3 G.M.V., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade shows little change on the week. Manufacturers still complain considerably of unremunerative prices. Home and continental consumers are in the market at current rates, but are not inclined to follow the substantial rise producers declare to be necessary to place values on an economic level. Terms of contract are a matter of individual negotiations, and vary a good deal, but the basis of values may be put at 76s. to 76s. 6d. for ordinary qualities. Manufacturers declare that cost of production is well over 80s., and, as they are fairly well sold, they are not keen to enter into further extensive commitments at present. Merchants, also, in view of possible early advances in quotations, are not anxious to unload their holdings at current figures.

Ironmaking Materials.

Sales of foreign ore are reported to have been made at substantially below the prices that have been nominally quoted of late, but this has not weakened the hands of sellers. Merchants are not in a position to negotiate for sales except for delivery well ahead, and consumers, being heavily bought, are not disposed to negotiate for further supplies. Blast-furnace coke quotations show a further marked upward movement. Notwithstanding forthcoming heavy additions to output, apprehension is felt that supply may be inadequate to the growing needs. The minimum price named for good average qualities delivered at North-East Coast works is 23s.

Manufactured Iron and Steel.

Continental producers of semi-finished steel are once more making a big attempt to secure orders in the North of England, and with that object are cutting prices, but the reductions they have made are insufficient seriously to affect producers in this district, who report a fair number of contracts still coming to hand. In the finished steel trade, too, Northern works are securing a few contracts, and are busy. Following on more orders for steamers, specifications for shipbuilding materials are being distributed fairly freely, and in other departments, particularly for constructional steel, the outlook is satisfactory. Prices show little or no change.

Order for Tyneside Firm.

A. Reyrolle and Co., Ltd., the Hebburn firm, has secured the Electricity Board contract for a 33,000-volt metal-clad switchgear for the London area. A few months ago the same firm secured an order for a 132,000-volt switchgear for the South-Eastern Counties electrical grid scheme. These contracts will ensure full employment for the firm for a considerable time. The works are being extended by the addition of several new bays.

The Coal Trade.

Prices are unchanged for practically all classes of coal, except that for prompt lots fitters continue to offer discounts. Northumberland coals are still more steadily placed than Durham varieties, for which prices are irregular, owing to tonnage shortage and a less vigorous inquiry. The steam coal trade is in a very healthy state, and best qualities are commanding higher prices. These are quoted at 16s. for this month and 16s. 6d. for October. There is more or less a full business for Tyne primes, which are 15s. 3d. to 15s. 6d., and seconds are steady at 14s. 6d. to 14s. 9d. Small steams are in maintained request at recent firm values, bests and other prime sorts being at from 10s. to 10s. 6d., and seconds 9s. 3d. to 9s. 6d. Prompt turns with some of the Durham collieries are gradually filling up, and while trade is still quiet the position is a little better. Good-class Durham steams again show animation, and the feeling is firm, with large sorts quoted at 18s. to 18s. 6d., and smalls at 12s. 6d. to 13s. Gas fuel is in good inquiry, and prices are steadier at 16s. 9d. to 17s. for best qualities, and 15s. to 15s. 6d. for ordinaries. Coking coal is not lacking in offer, but sellers hold steadily for 15s. 6d. to 16s. for the best grades and 15s. for smalls. The market for foundry coke continues strong. The demand on home account is very appreciable, and export business provides a good fillip. There is a scarcity of ordinary foundry coke, and 25s. is now a minimum quotation. Special kinds of foundry coke range steadily from 26s. up to 32s. 6d.

SCOTLAND.

(From our own Correspondent.)

Improving Tendency.

THE effects of the holiday season are rapidly disappearing and trade is beginning to improve in several directions. Indications are not lacking that inquiries for steel and iron are likely to become more plentiful, and orders more numerous. Continental competition has been very keen during the past month or two, but the upward tendency in these markets though slight, may perhaps be regarded as a turning point. The scheme for the reorganisation of the coal industry is awaited with keen interest, and until the terms are made known and adopted, prospects can hardly be assessed, as in all probability a considerable amount of business may or may not be concluded or accepted under new conditions.

Steel.

The outlook in the steel trade is said to be more favourable. General demands are fairly steady, and plants are regularly employed. Shipbuilding requirements are representing a fair volume of work, and locomotive and structural engineers are placing a considerable number of orders. A gradual improvement is noticeable in steel sheets, more especially in respect to the demand from Eastern markets which have been very dull for the past three or four months. Business in tubes is improving again, and some of the works experience considerable pressure for deliveries.

Iron.

Business in bar iron is, if anything, slightly better, but there is still ample room for improvement. In the rolled steel bar section makers still meet keen competition from abroad, and the prices obtainable have been exceptionally keen. More orders are now coming to hand, and this is probably due to the stiffening tendency in continental prices. Meanwhile the local quotations for rolled steel bars are unchanged at £8 home and £7 15s. per ton export.

Pig Iron.

The output of pig iron is not large, but the production is steadily disposed of at the agreed prices. Of late there have been offerings of continental basic iron in this district, but very little business has been done, and the movement is not regarded as serious in a competitive sense.

Scrap.

Supplies of scrap material are not too plentiful, and quotations remain firm as follows:—Heavy steel £3 16s. 3d., and cast iron machinery scrap £3 10s. per ton.

Coal.

There has been no outstanding change in the Scottish coal trade during the past week. The collieries are well placed for orders meantime, and outputs are readily disposed of against contracts. Consequently any available fuel is fetching full market prices. Foreign business is quiet for prompt loading, while practically nothing is being done for forward delivery. Lanarkshire splints and ells and Fifeshire prime steams, especially the last-named, are strong features in a firm market for round coal. All sizes of washed nuts are scarce and very firm. Aggregate shipments amounted to 292,885 tons, against 301,157 tons in the preceding week and 280,330 tons in the same week last year. As was anticipated no Scottish tenders for coal were accepted by the Swedish State Railways, and it has been announced that tenders for coal for the Latvian State Railways were rejected also.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Outlook.

As time goes on there is increasing anxiety as to what will emerge from the discussions, &c., regarding hours and wages and the question of a national agreement as against district agreements in the coalfield. The fact that the Prime Minister has entered into the controversy and ranged himself on the side of the miners has rather accentuated the anxious feeling that prevails, especially as the coalowners are definitely opposed to anything in the nature of a national agreement. Naturally, fears are entertained that there will be the usual drift towards a crisis, which is so detrimental to business, and which is not avoided by a last-minute settlement. In fact, there is already speculation whether business even now is not suffering to some extent from the fears that if period contracts are entered into delivery will be endangered by the possibility that there may be an interruption of work in the coalfield at the end of the year. The possibility that orders may be withheld is a very real one, and if matters go on as they are it will become a certainty that foreign buyers will look elsewhere for their requirements ahead.

Coal Contracts.

Despite the uncertain outlook there is the satisfaction that some fairly substantial business has been done in Welsh coals for delivery from now to the end of next year. The well-known French shipping company, Cie Generale Transatlantique, is reported to have bought 200,000 tons, consisting of large and smalls, for shipment between now and the end of next year, on the basis of 19s. to 19s. 9d. for large and 13s. 6d. to 13s. 9d. for smalls; while the Central Argentine Railways have bought half a million tons of best and second-class Admiralty large coals for delivery over next year on the basis of the new schedule prices of 19s. 6d. to 20s. It is also understood that other business has been done for South American Railways, and collieries are looking for further inquiries for supplies from that direction. The M.Z.A. Railways of Spain are reported to have placed their order for about 20,000 tons of Welsh coals for delivery during the last three months of this year. While this business is satisfactory, the fact remains that the demand for prompt loading is far from adequate to the needs of the collieries, especially so far as large qualities are concerned. The shortage in the inquiry for large coals has caused the interruption of work at quite a number of pits, and a number of salesmen have had to resort to the stipulation that buyers who require smalls must take a proportion of large to help collieries out of their immediate difficulties. Shipments last week were disappointing, but were only in accordance with expectations, owing to the fact that tonnage at the disposal of collieries was inadequate. On Saturday last the number of idle tipping appliances reached the high figure of thirty-eight and only four steamers were waiting, while on Monday the position was not much improved as the result of arrivals, as the number of idle appliances was twenty-one and only seven vessels were waiting. Certainly chartering last week was better than for several weeks previously, thus holding out the prospect that the position of collieries will be better during the second half of the month, but at the same time it cannot be denied that the current inquiry for coals is extremely quiet.

Demonstration of New Coal-loading Appliance.

Members of a sub-committee appointed by the South Wales Area Trimming Board visited Swansea on Monday to see in operation a new device for minimising the breakage of coal in the loading of cargoes, viz., Hancock's patented coal escalator. This apparatus was fixed to No. 1 tip at the King's Dock. The escalator was lowered into the hold of the vessel, and fixed by a nose to the end of the chute. The coal from the chute falls on to plates fixed to an endless chain, and by its own weight is carried to the bottom, where it falls out on to the floor of the hold. There is a prospect that the appliance will be installed at all the ports in this channel. The sub-committee which inspected its working has to report back to the Trimming Board, as questions have arisen affecting the trimmers and tippers.

Traffic at South Wales Ports.

The G.W.R. Company has issued its statistics regarding the traffic at the ports in this channel under its control for the four weeks ended September 1st last. The figures show that the total imports and exports came to 2,942,906 tons, which compares with 2,414,201 tons for the corresponding period of last year, an increase of 528,705 tons. Imports came to 464,115 tons, as against 390,622 tons, and exports amounted to 2,478,791 tons, as compared with 2,023,579 tons. Taking the whole of this year to September 1st, the aggregate of trade for the six ports in question was 25,593,160 tons, which compares with 23,421,419 tons for the same period of 1928 and with 25,984,582 tons for the same period of 1927.

Current Business.

The general tone of the steam coal market is very quiet, and it is difficult for many collieries to maintain regularity of work, owing chiefly to the restricted inquiry for large coals. The best Admiralty qualities are comparatively well off for prompt orders, but all other descriptions are none too well placed. The shortage of demand for large coals means that, with output curtailed, the supply of smalls is inadequate to buyers' needs, and the result is that smalls and sized coals are very firm. Coke finds a ready market and patent fuel is very steady. Pitwood is round about 34s. to 35s., but the market is very unsettled, owing to reports of further labour troubles at Bordeaux and adjacent ports.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE telephone number of the Reliance Telephone Company, Ltd., Goschen Buildings, Henrietta-street, London, W.C. 2, has been changed from Regent 1010 to Temple Bar 1010 (four lines).

THE GENERAL ELECTRIC COMPANY, Ltd., announces that Mr. H. Wynne Roberts, sales manager of the company, and Mr. F. Winstanley, manager of the Illuminating and Domestic Appliances Departments, have been appointed directors of the company.

GABRIEL, WADE AND ENGLISH, Ltd., ask us to announce that while they have transferred their wholesale sawn wood business in Hull and West Hartlepool to Richd. Wade, Sons and Co., Ltd., they will continue their business in creosoted poles for overhead transmission lines, &c. &c., without any alteration at Staddlethorpe (Hull), and Ellesmere Port, under the same management as heretofore.

CONTRACTS.

THE CENTRAL ELECTRICITY BOARD has placed the following contracts, amounting approximately to £808,000, for work in connection with the undermentioned schemes:—South-East England: for 33-kV and other cables with British Insulated Cables, Ltd., Prescot, Lancashire; and for 33-kV and lower voltage switchgear with A. Reyrolle and Co., Ltd., Hebburn-on-Tyne. Mid-East England: for 132-kV overhead transmission lines with the General Electric Company, Ltd., Witton, Birmingham.

THE ALBION MOTOR CAR COMPANY, Ltd., of Scotstoun, Glasgow, has secured from the Government of India an order for over 200 rigid six-wheeled vehicles with a carrying capacity of three tons. The value of this contract approaches a quarter of a million pounds sterling, and the order is one of the biggest ever placed for heavy motor transport vehicles. The machines are of a special type with the driver's cab in a forward position, thus giving more body space without increasing the overall length of the vehicle.

THE GENERAL ELECTRIC COMPANY, Ltd., has secured from the Central Electricity Board a contract for the erection of 132-kilovolt overhead transmission lines for Mid-East England. The erection work will be carried out by the Pirelli-General Cable Works, Ltd., Southampton. The contract covers the supply and erection of 320 miles of 132-kilovolt lines, which will be identical in construction with the overhead lines which the General Electric Company, Ltd., and the Pirelli-General Company are now erecting for the Electricity Board in South-East England. The total value of the contract is £494,836.

LAUNCHES AND TRIAL TRIPS.

VIKINGEN, floating whale oil factory; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Viking Whaling Company, Ltd.; dimensions, 490ft. by 71ft. by 34ft. Engines, triple-expansion, pressure 210 lb. per square inch; constructed by the builders; trial trip, recently.

MID OCEAN, twin-screw steamer; built by Blythswood Shipbuilding Company, Ltd., to the order of Bermuda and West Indies Steamship Company, Ltd., Hamilton, Bermuda; dimensions, 180ft. by 33ft. 6in. by 16ft.; to carry passengers and cargo. Engines, triple-expansion; constructed by J. G. Kincaid and Co., Ltd.; launch, August 30th.

SAINT CLAIR, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Société Française d'Armement, Marseilles; to carry cargo. Engines, triple-expansion with Bauer-Wach low-pressure turbine, pressure 180 lb. per square inch; constructed by the builders; a speed of 12 knots was attained on trial trip, August 31st.

THE JUNIOR INSTITUTION OF ENGINEERS.—Sir Ernest William Moir, Bt., M. Inst. C.E., has accepted the invitation of the Council to become President of the Institution in succession to Lt.-Col. J. T. C. Moore-Brabazon, M.C. His induction will take place at a meeting to be held at the Royal Society of Arts on Friday, December 13th next, when he will deliver a presidential address. The winter session of the Institution opens on October 4th, 1929, with a meeting which will be held at 7.30 p.m. in the Lecture Room of the Institution at 39, Victoria-street, when a paper entitled "Engineering Experiences on a Tea Estate in Assam" will be read by Mr. C. J. Hill (member).

THE "SUNBEAM."—We learn that Thos. W. Ward, Ltd., Sheffield, have purchased from Sir Walter Runciman, Bart., the famous yacht "Sunbeam." She belonged originally to the late Earl Brassey, and fifty years ago went round the world on a twelve months' tour with Lord and Lady Brassey on board. A graphic account of this voyage is given in Lady Brassey's well-known book "A Voyage in the 'Sunbeam.'" The vessel is the most famous of privately owned British yachts and holds the world's record for mileage, having travelled over half a million miles in the course of her existence. Twenty-five years ago she took part in the Transatlantic race for the Kaiser's Cup, and during the war served in the Dardanelles as a hospital ship. The vessel was designed by Mr. St. Clare Byrne and is 157ft. long and 27ft. 6in. extreme beam, with a displacement of 531 tons. She was expected to reach the Morecambe works of T. W. Ward, Ltd., on Wednesday, and will no doubt be of great interest to visitors.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/-
(1) Spanish	24/- to 25/-
(1) N. African	24/- to 25/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	24/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 16 0	3 16 0
No. 1	3 16 6	3 16 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
„ „ Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 12 6	—
Forge	3 8 6	—
(1) Derbyshire—		
No. 3 Foundry	3 16 0	—
Forge	3 12 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 5 6 (*a*) 4 7 6 (*b*) 4 11 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ⅜in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 7 6
Sheets (Gal. Cor. 24 B.G.)	13 17 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 5 0 to 8 15 0	—
Billets and Sheet Bars	6 10 0 to 6 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/9
Block Tin (cash)	205 7 6
„ „ (three months)	209 5 0
Copper (cash)	74 2 6
„ (three months)	74 12 6
Spanish lead (cash)	23 10 0
„ „ (three months)	23 12 6
Spelter (cash)	24 6 3
„ (three months)	24 16 3
MANCHESTER—	
Copper, Best Selected Ingots	80 10 0
„ Electrolytic	85 5 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	25 2 6
„ Foreign	23 15 0
Spelter	25 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/6½ per lb.	
Ferro Tungsten	3/3½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£23 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£23 0 0	6/6
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£34 0 0	12/-
„ „ „ 1 p.c. carbon	£38 0 0	15/-
„ „ „ 0·70 p.c. carbon	£42 0 0	17/-
„ „ „ carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	13/- per lb.	
„ Molybdenum	4/- per lb.	
„ Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	15/6
„ „ Splint	16/6 to 18/-
„ „ Trebles	16/-
„ „ Doubles	15/-
„ „ Singles	13/- to 13/6
AYRSHIRE	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	16/-
„ „ Trebles	16/-
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/- to 15/6
Screened Navigation	17/6 to 18/6
Trebles	16/6 to 17/6
Doubles	15/6
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/- to 14/6
Secondary Steam	13/6
Trebles	17/-
Doubles	15/6
Singles	13/- to 13/6

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	21/6 to 22/-
Household	38/- to 51/-
Coke	26/6 to 27/6
NORTHUMBERLAND—	
Best Steams	16/- to 16/6
Second Steams	14/6 to 14/9
Steam Smalls	10/- to 10/6
Unscreened	13/- to 13/6
Household	21/- to 26/-
DURHAM—	
Best Gas	17/-
Second	15/6 to 16/-
Household	21/- to 27/-
Foundry Coke	25/- to 30/-
SHEFFIELD	
Best Hand-picked Branch	26/6 to 28/-
Derbyshire Best Bright House	21/- to 23/-
Best House Coal	20/6 to 21/6
Screened House Coal	18/6 to 20/-
„ „ Nuts	16/6 to 18/-
Yorkshire Hards	15/6 to 17/-
Derbyshire Hards	15/6 to 17/-
Rough Slacks	9/- to 10/-
Nutty Slacks	7/- to 8/-
Smalls	3/- to 5/-
Blast-furnace Coke (Inland)	14/6 at ovens
Furnace and Foundry Coke (Export), f.o.b.	22/- to 23/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/9 to 20/-
Second Smokeless Large	19/6 to 19/9
Best Dry Large	18/9 to 19/-
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/- to 18/3
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/9 to 14/6
Ordinary Smalls	12/6 to 13/-
Washed Nuts	22/6 to 28/-
No. 3 Rhondda Large	20/- to 21/-
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/6
„ „ Through	15/6 to 16/6
„ „ Smalls	13/6 to 14/-
Foundry Coke (Export)	26/6 to 36/6
Furnace Coke (Export)	21/- to 23/-
Patent Fuel	21/6
Pitwood (ex ship)	33/6 to 34/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	33/- to 36/6
Seconds	27/6 to 30/-
Red Vein	23/- to 27/-
Machine-made Cobbles	40/- to 44/-
Nuts	40/- to 44/-
Beans	23/6 to 25/6
Peas	19/- to 19/6
Breaker Duff	9/9 to 16/-
Rubbly Culm	11/3 to 11/9
Steam Coals :	
Large	18/- to 19/-
Seconds	17/- to 18/
Smalls	11/3 to 13/-
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum) 12/6

Ordinary Ship, Bridge and Tank Plates and Sections 10/- if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Trade.

THE activity in the steel trade has slackened somewhat recently, but the tendency is nevertheless distinctly firm in view of the increasing quantity of material required over a long period on account of the extensive State-aided building programme which is to be carried out, while the much smaller amount of material to be supplied by Germany on reparations account is expected to result in the provision of more employment to constructive engineering firms. There is, however, an element of uncertainty in the international market, in which prices have weakened, and steelmakers have little hope of an improvement unless it can be provided by a renewal of the Steel Cartel at the forthcoming meeting in Vienna. It is fairly evident that the Cartel will be renewed, although it is believed that that course will only be possible by conceding the claims of Belgium and Germany to larger quotas. Germany has made it a condition of renewal that the Cartel shall be associated with an organisation for controlling the export trade, and, while it is doubtful whether an agreement will be come to at the meeting for the constitution of a sales' agency, it is probable that something will be done to ensure more remunerative prices for export orders. The French hesitate to enter into a firm agreement for fear of opening the way to competition from Great Britain, and particularly from the United States, but it is clear that if the steel production is increased, as is declared probable, there will necessarily be severe price cutting unless some arrangement is come to for controlling foreign business.

The Coal Trade.

The proposals made at Geneva to regulate the international coal trade and to prepare the way for a European economic federation by a general agreement to effect no change in the existing fiscal tariffs during a period of two years are meeting with little favour in this country. Protests are already being made against any arrangement which may restrict the liberty of France to do what she deems necessary for the protection of industry. The coal mining industry especially refuses to place itself under any international control. The reconstructed collieries are so well equipped and the organisation in the Nord and the Pas de Calais is so complete that coalowners are strong enough to resist any attempt to limit their activities, and it must be admitted that the general feeling is not favourable to any restrictive action suggested by the British Government for relieving the British coal trade the situation of which is attributed largely to the effects of the miners' strike in 1926. The point to be emphasised is that the British proposals are not meeting with sympathetic consideration, at least in France, and it may be unwise to count on their being put into effect.

Gas Distribution.

The chief remedy proposed for decentralising the population for the benefit of rural industries is the national electrification scheme. One of the objects of that scheme is to reduce the importation of coal, but it is now recognised that electricity does not provide everything, and that if decentralisation is to be encouraged, those leaving towns for rural districts will find that gas is more convenient to them even than electricity. Following upon the success of the long distance distribution of high-pressure gas in Germany as well as in the Department of the Nord, it is felt that some similar organisation must be adopted in order that those living in rural districts may enjoy the same conveniences as town dwellers. The technical difficulties in the way of gas distribution under pressure over long distances have been overcome. The system is particularly economical in the case of a large gas production at the collieries. It can hardly be expected that the coal in the Nord and the Pas de Calais, which is suitable for coking will be available beyond the limits of the northern departments, and if the system is to be extended elsewhere it may be possible to follow the example of the new Alsacian company which is erecting coke ovens for the distribution of gas with the aid of coal supplied by French, Belgian, German and other collieries. There is no reason why, in the same way, gas should not be distributed over the southern part of France from coal imported from Great Britain.

Powerful Electric Locomotive.

On the electrified section of the P.L.M. railway between Culoz and Modane, where the gradients are particularly steep, an electric locomotive, which is claimed to be the most powerful in the world, is now being tested in actual service. It was built by the Société Oerliken, the Société de Construction des Batignolles and the Compagnie Générale de Construction of Nantes. Its length is 78ft., and the total weight is 158 tons. Although there are more powerful articulated locomotives in the United States the P.L.M. locomotive is stated to be the largest comprising a single body on two bogies each with three driving axles. The six motors, developing altogether 5400 horse-power, drive through flexible transmissions, and direct current is supplied at 1500 volts. The contact is by third rail, except through certain stations where a trolley is employed. The maximum speed attained is 81 miles an hour, but it is reduced to 61 miles on the more difficult section between Chambéry and Modane. It is stated that the locomotive will haul a load of 700 tons at an average speed of 47 miles an hour on gradients of 15 mm. per metre.

Steel Houses.

Because of the necessity of providing accommodation for those who have been expelled from the military zone around Paris, the authorities have under consideration a proposal to construct steel houses in the industrial suburb of La Courneuve. As an experiment about fifty houses will be built, and if satisfactory about 1500 houses of the same type will be constructed. It is claimed that being composed of standard sections they are cheap, and it is hoped that they will provide a new outlet for steel.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

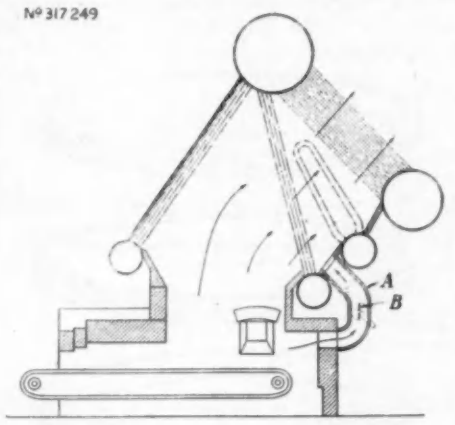
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

317,249. September 14th, 1928.—SUPERHEATERS FOR WATER-TUBE BOILERS, H. E. Yarrow, Scotstoun, Glasgow.

The object of this invention is to provide means for regulating the final temperature of the steam leaving the superheater of a water-tube boiler. Such superheaters derive their heat from furnace gases which have previously traversed one or more banks of steam generating tubes, and according to the present

Nº 317,249

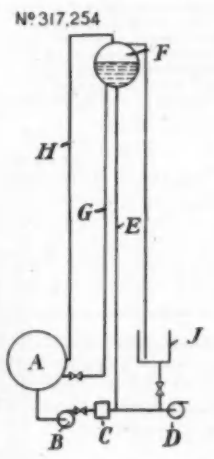


invention means are provided whereby furnace gases are by-passed directly from the combustion chamber to the superheater without first traversing any of the steam-generating tubes of the boiler, thereby increasing the temperature of the superheater. The amount of this increase is regulated by controlling the quantity of hot gases by-passed to the superheater. The by-pass is plainly shown at A and its regulating damper at B.—*August 15th*, 1929.

CONDENSERS AND FEED-WATER HEATERS.

317,254. October 3rd, 1928. —FEED-WATER SYSTEMS, P. J. Robinson, The Cove, Uppingham-road, West Derby, Liverpool.

Nº 317,254



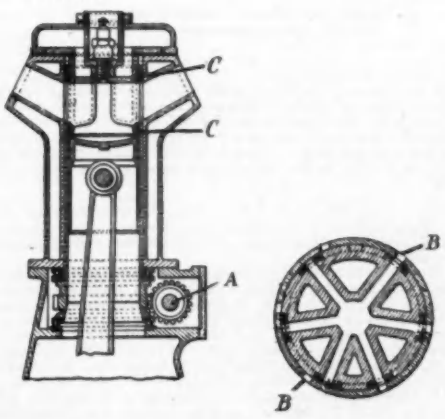
Condensate is extracted from the condenser A by the pump B, and passes through a non-return valve to the feed heater C. It then goes to the boiler feed pump D. In the delivery from the feed heater there is a branch E leading up to the surge tank F. There is also a connection G back to the condenser. The result is that there is a continuous circulation of water through the surge tank, which is warmed by the feed heater. Any air in the water in the surge tank is liberated and is drawn off to the condenser by the connection H. The tank J catches any overflow from the surge tank and assists in supplying the feed pump during periods of maximum demand.—*August 15th*, 1929.

INTERNAL COMBUSTION ENGINES.

317,253. September 26th, 1928.—SLEEVE VALVE ENGINES, C. Langner, 132, Zwickauerstrasse, Dresden-A., Germany.

In this engine the sleeve valve is rotated by the gear A.

Nº 317,253



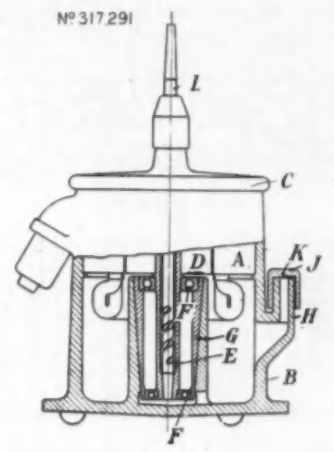
and is provided with slots B B at the top. These slots act in conjunction with slots in the cylinder walls for the admission of the charge, and for exhaust. Within the cylinder head there is a water-cooled projection, with passages as shown in the cross section for the ingress and egress of the gases. Packing rings are provided at C C to make a tight joint for the sleeve.—*August 15th*, 1929.

DYNAMOS AND MOTORS.

317,291. June 13th, 1928.—ELECTRIC MOTORS FOR DRIVING SPINNING CANS AND THE LIKE, Frederick Newton, Alfreton-road, Derby.

The yoke of the stationary field A is a cylinder B closed at its lower end and having a cap C screwing upon its upper end. The rotor D is secured upon a hollow shaft E, supported in ball or roller bearings F, the outer races of which are carried in a coned sleeve G fitting a correspondingly coned cup upstanding

Nº 317,291



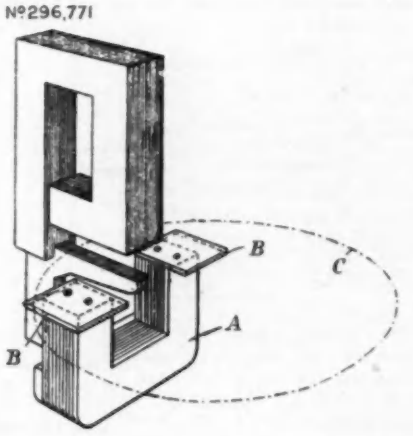
from the bottom of the cylinder B. A lateral tubular projection H upon the cylinder projects upward to approximately the level of the bearing F, and forms an inlet for oil. It is normally covered by a cap J, which leaves a breathing space K. The spinning can, which is not shown, is carried upon a stiff solid or hollow shaft L, which is resiliently connected at its lower end, with the lower end of the shaft E, though, if desired, a flexible shaft may be employed.—*August 15th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

296,771. April 24th, 1928.—DRIVING SYSTEM FOR INDUCTION MEASURING INSTRUMENTS, Landis and Gyr S.A., of Hofstrasse 1, Zug, Switzerland.

On the front faces of the poles of the current magnet core A pieces of sheet ferro-magnetic material B are secured by means

Nº 296,771



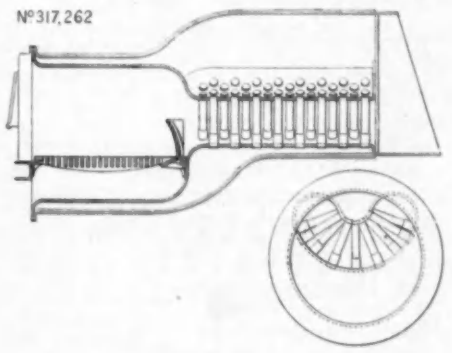
of screws, the surfaces of these metal sheets being larger than the pole faces. By these means the reluctance of the magnetic circuit of the current coil flux is reduced. Experiments have shown that the provision of these plates considerably increases the turning moment of the disc C.—*August 15th*, 1929.

MOTOR CARS AND ROAD TRAFFIC.

317,262. October 29th, 1928.—BOILERS FOR STEAM TRACTORS, E. R. Foden, Elworth Works, Sandbach, Chester.

It is claimed that this boiler does not require any stays.

Nº 317,262



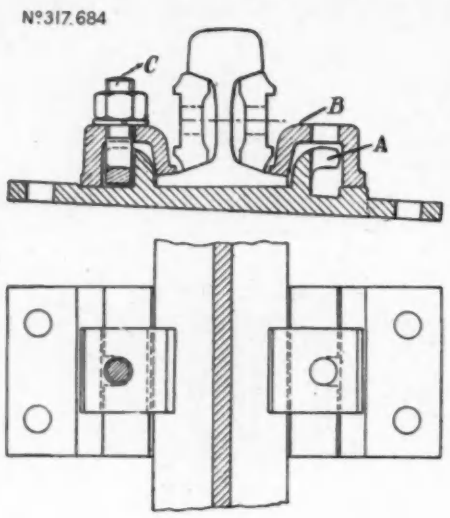
The outer shell is of circular cross section, but is cranked as shown. The fire-box also is circular, but is kept below the water level on account of the cranked form of the shell. The flue is

of approximately kidney-shaped cross section, and within this part there are a number of water-tubes. The fire-box and flue are made in one piece by pressing and welding, and can be withdrawn from the outer shell.—*August 15th*, 1929.

TRAMWAYS AND RAILWAYS.

317,684. November 13th, 1928.—RAILWAY CHAIR PLATES, Eisen-u Stahlwerk Hoesch Aktiengesellschaft, Dortmund, Westphalia, Germany; and C. Schaefer, 103, Stahlwerk strasse, Dortmund.

This chair plate is provided with lugs A which are used in con-

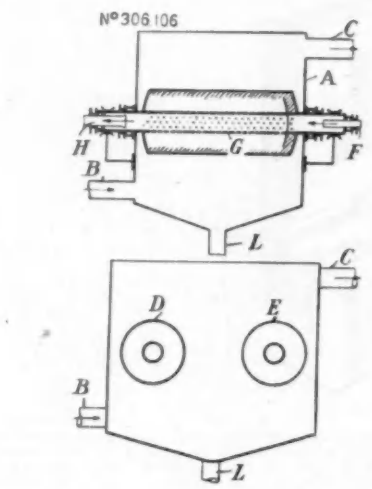


junction with "holding-down devices" B. The lugs are slotted to receive the heads of bolts C. The heads of these bolts are slightly rounded to accommodate any relative movement of the several parts. The chair plate is, of course, appropriately attached to the sleeper.—*August 22nd*, 1929.

MISCELLANEOUS.

306,106. April 27th, 1928.—SEPARATING SUBSTANCES FROM GASES BY COOLING, Kali-Industrie Aktiengesellschaft, of 139, Hohenzollernstrasse, Kassel, Germany.

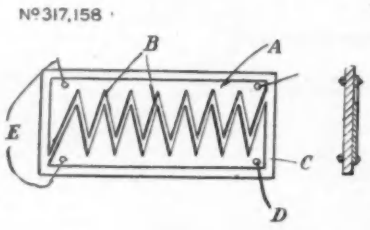
This invention is concerned with the separation of substances from gases by cooling. In the drawing, A indicates a vessel or chamber traversed by the gas to be cooled, B is the inlet for gas, and C the outlet for the cooled gas. The two hollow rolls or drums D and E are journalled in bearings sealed against the gas chamber by stuffing-boxes. The cooling or refrigerating



liquid serving as cooling agent enters the hollow shafts of the drums at F and passes by way of openings G into the interior of the drums over the inner walls of which it flows. It is thus evaporated by the heat given up by the gases to be cooled and the vapour is drawn off at H. Stuffing-boxes seal the stationary feed and discharge pipes. The speed of rotation of the drums or rolls may be made so high that deposits formed on the outer surface of the drums or rolls are thrown off by centrifugal action and are collected in the lower part of the vessel, whence they may be drawn off through a pipe L.—*July 29th*, 1929.

317,158. May 31st, 1928.—SELENIUM BRIDGE OR CELL, John Neale, of 15, Acacia-road, St. John's Wood, London, N.W. 8.

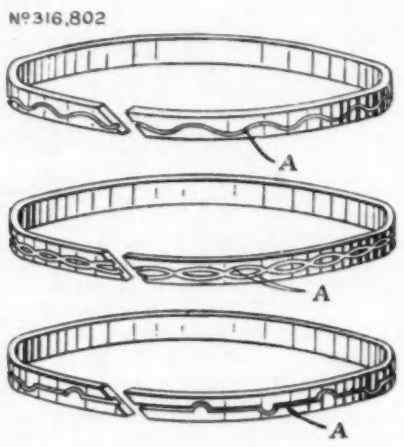
The electrodes of the bridge or cell are constituted by thin metal sheets, of relatively large area which are stamped or



otherwise formed with projecting fingers of spike-like formation, the fingers of the two electrodes inter-engaging and a very slight gap being left between them. The electrodes may be mounted upon an electrically insulating base of suitable material, or may be placed between a pair of plates, in sandwich formation, one or both of the plates being translucent. If a single base is employed, it is preferably composed of a material which can be rendered plastic under suitable treatment, the electrodes being partially embedded therein by the application of the requisite pressure. "Bakelite" or vulcanised rubber may be employed, also insulating compounds manufactured from bituminous substances, cellulose acetate, casein compounds, and other materials of this nature may be used. Where the cell is made up in sandwich formation, one at least of the plates must obviously be translucent in nature, and the preferable substance for this purpose is glass. In the drawing, A are the electrodes stamped from thin sheet metal and provided with spike-like inter-engaging fingers B. These electrodes are mounted upon a base plate C. Rivets D may be provided for greater security and for attachment of the necessary conductor leads E. It will be understood that after the electrodes are mounted they are then thinly coated with selenium and annealed and seasoned in the usual manner.—*August 15th*, 1929.

316,802. September 15th, 1928.—PISTON PACKING RINGS, William Arthur Oubridge, of "Parklands," Park-road, Coventry, Warwickshire.

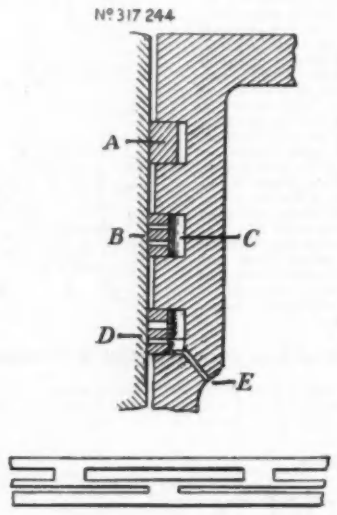
In accordance with this invention a groove A is formed around the outer periphery or acting surface of a piston ring, the groove being of a sinuous nature, so that the crests of the curve are brought close to the edges of the ring. The distance from crest to crest may be determined from such considerations as the number



of piston strokes per minute, the quality of the lubricant to be employed, and the pressure exerted by the ring on the cylinder walls. More than one groove may be provided parallel to one another, or, as shown in the middle illustration, they may cross one another so that the crest of one is opposite to the trough of the other. The groove may also comprise straight portions connected by portions waved in any manner, as is shown, for example, in the bottom illustration.—*August 8th*, 1929.

317,244. September 7th, 1928.—PISTON RINGS, *E. S. Andrews*, 201, *Bank Chambers*, 329, *High Holborn, London, W.C.* 1.

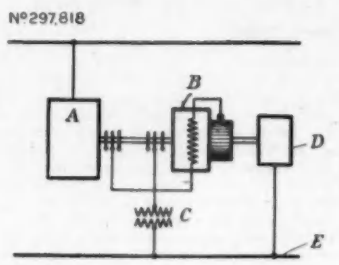
This piston ring is of the slotted type, and is intended to prevent the passage of oil up the cylinder walls. The piston is provided with a normal ring A at the top, and with a second ring B, which is slotted to give it axial resiliency and is expanded radially by a corrugated ribbon C. There is a third, slotted,



ring D in a groove with oil drain holes E. This ring has the grooves made in the form shown in the detail sketch, that is to say, with the upper grooves of considerably greater width than the lower ones. In this way the bearing surface of the ring on the cylinder wall is reduced, but the connecting bars are prevented from flexing beyond the safe limit.—*August 15th*, 1929.

297,818. August 17th, 1928.—A PROCESS FOR TESTING AND STARTING THE WORKING OF HIGH-TENSION LINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The line to be tested receives its voltage from an asynchronous machine A, the rotor of which is excited by a three-phase exciter machine B. The latter is excited through an adjustable voltage reducing device or transformer C. On the same shaft as the asynchronous machine A and the exciter machine B there is an auxiliary motor D connected to the network E. By means of this motor, the set of machines is brought to the desired number of revolutions before switching it on to the line network to be tested. The asynchronous machine A is therefore first switched on to the network without excitation, and gradually brought to the full voltage by increasing the excitation of the exciter machine B. A watt relay can be provided which breaks the excitation circuit of the exciter machine B by switching off the transformer C, when, owing to a faulty place in the line, a strong watt current is passing during the charging up, in addition to the wattless current supplied by the asynchronous machine. Owing to the operation of the relay, the asynchronous



machine A is de-energised so that the short circuit is no longer supplied with circuit current.—*August 15th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Western District meeting at Bebington and Bromborough, Cheshire. Assemble at Hulme Hall, Port Sunlight, 11 a.m. Paper on "Development and Works in the Bebington and Bromborough District," by Mr. Percy Parr.

TO-DAY AND SATURDAY, SEPTEMBER 21ST.

INSTITUTION OF WATER ENGINEERS.—Informal autumn meeting. Visits to the works of the Wakefield and Barnsley Corporations.

TO-DAY TO SATURDAY, SEPTEMBER 28TH.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in Italy. For programme see page 380, April 5th, 1929.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION, Olympia.

TUESDAY AND WEDNESDAY, SEPTEMBER 24TH AND 25TH.

FARADAY SOCIETY.—Physics Department of the University, Bristol. General discussion on "Molecular Spectra and Molecular Structure." Tuesday at 2.30, Wednesday at 10.30.

THURSDAY, SEPTEMBER 26TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—Denison House, 296, Vauxhall Bridge-road, London, S.W. 1. Paper, "Some New Developments in the Stephenson Boiler," by Herr R. P. Wagner. 6 p.m.

FRIDAY, SEPTEMBER 27TH.

INSTITUTE OF BRITISH FOUNDRYMEN: SHEFFIELD AND DISTRICT SECTION.—King's Head Hotel, Sheffield. Presidential Address, by Mr. G. L. Oxley. 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—Cinema Hall, Olympia, London, W. Lecture, "Modern Tanker Practice," by Mr. H. Barringer. 6.30 p.m.

FRIDAY AND SATURDAY, SEPTEMBER 27TH AND 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Institution meeting to be held in the Isle of Ely.

TUESDAY, OCTOBER 1ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Automobile Club, Pall Mall, London, S.W. 1. Presidential address, "The Member and the Institution," by Professor W. Morgan. 8 p.m.

FRIDAY, OCTOBER 4TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Engineering Experiences on a Tea Estate in Assam," by Mr. C. J. Hill. 7.30 p.m.

TUESDAY, OCTOBER 8TH.

ILLUMINATING ENGINEERING SOCIETY.—E.L.M.A. Lighting Service Bureau, 15, Savoy-street, Strand, London, W.C. 2. Report on Progress in Illuminating Engineering. 6.30 p.m.

THURSDAY, OCTOBER 10TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, 18, John-street, Adelphi, London, W.C. 2. Lecture, "The Range of Aircraft," by Mr. C. R. Fairey. 6.30 p.m.

FRIDAY, OCTOBER 11TH.

CHEMICAL ENGINEERING GROUP.—Burlington House, Piccadilly, London, W. 1. "Rationalisation—its Meaning and Application," by Mr. J. Davidson Pratt. 8 p.m.

WEDNESDAY, OCTOBER 16TH.

OVERHEAD LINES ASSOCIATION.—At the Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Annual general meeting. 5.30 p.m.

THURSDAY, NOVEMBER 21ST.

BRITISH WATERWORKS ASSOCIATION.—Public Works Congress at the Agricultural Hall, London. Papers: "Water Supply as a Factor in Town and Regional Planning," by Mr. G. L. Pepler, F.S.I.; "The Preservation of Rivers and Streams from the Standpoint of Water Supply: Some Observations on River Pollution," by Dr. J. B. Firth; "The Purity of Drinking Waters from a Biological Aspect," by Dr. W. Rushton.